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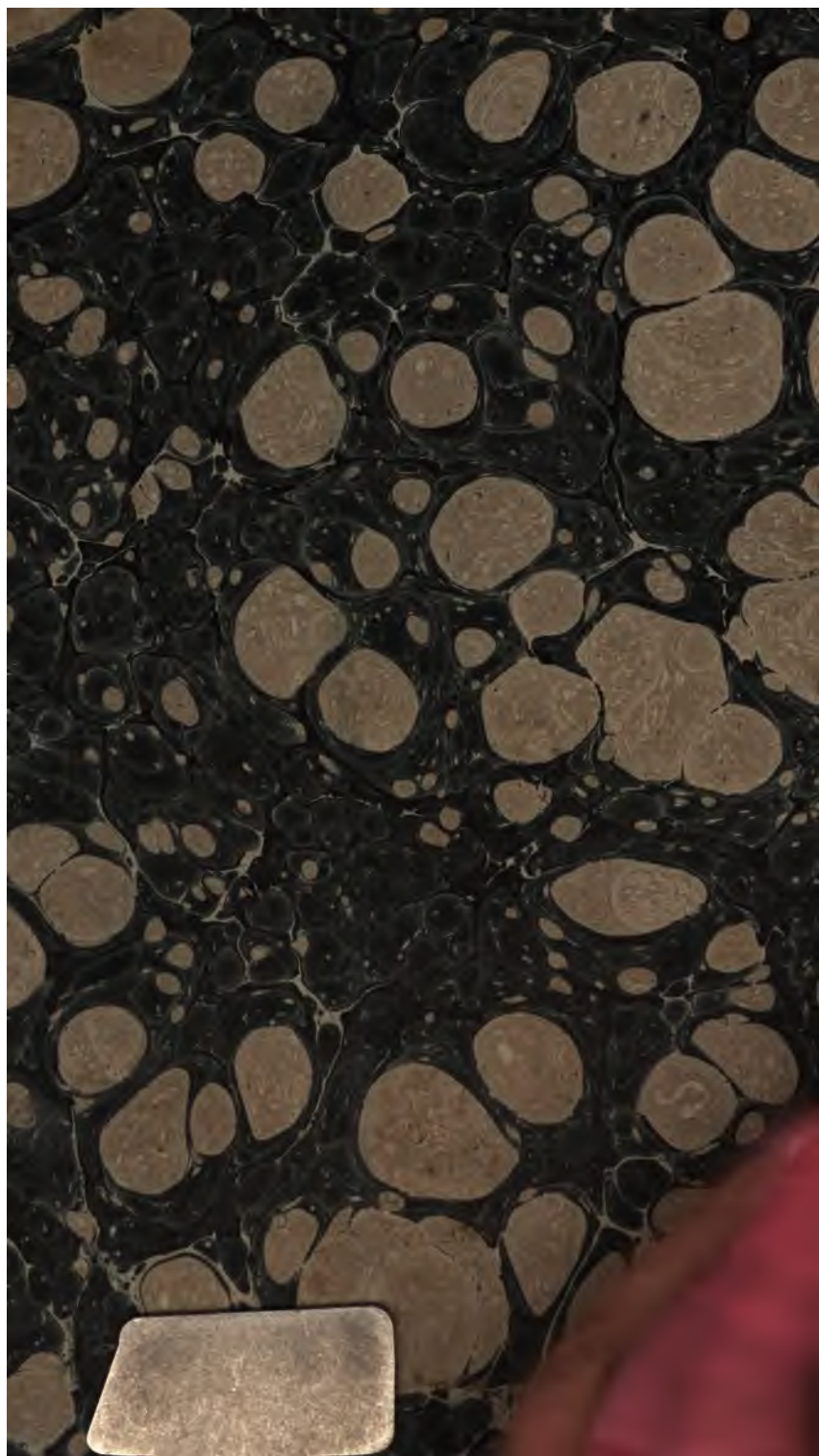
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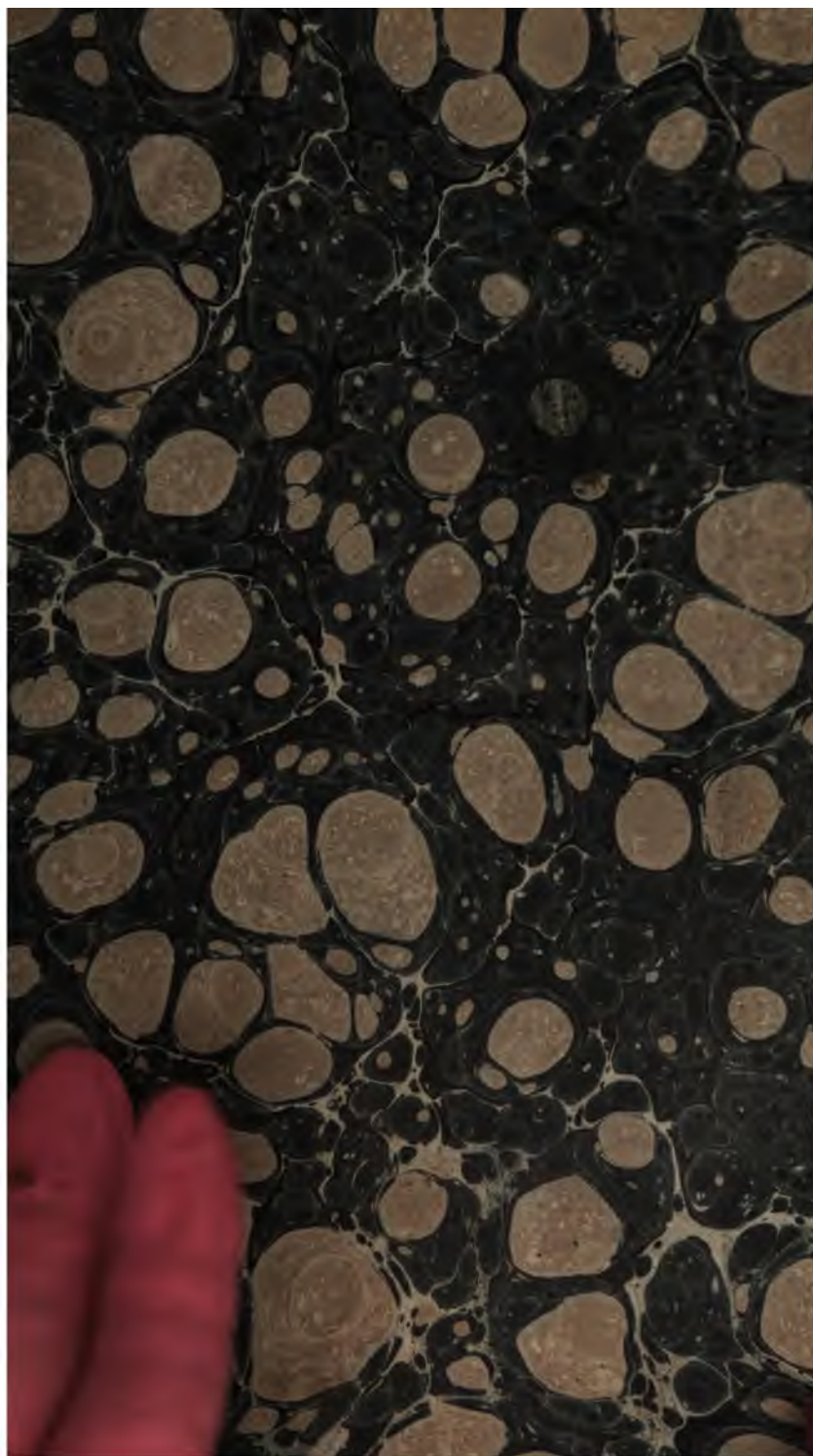
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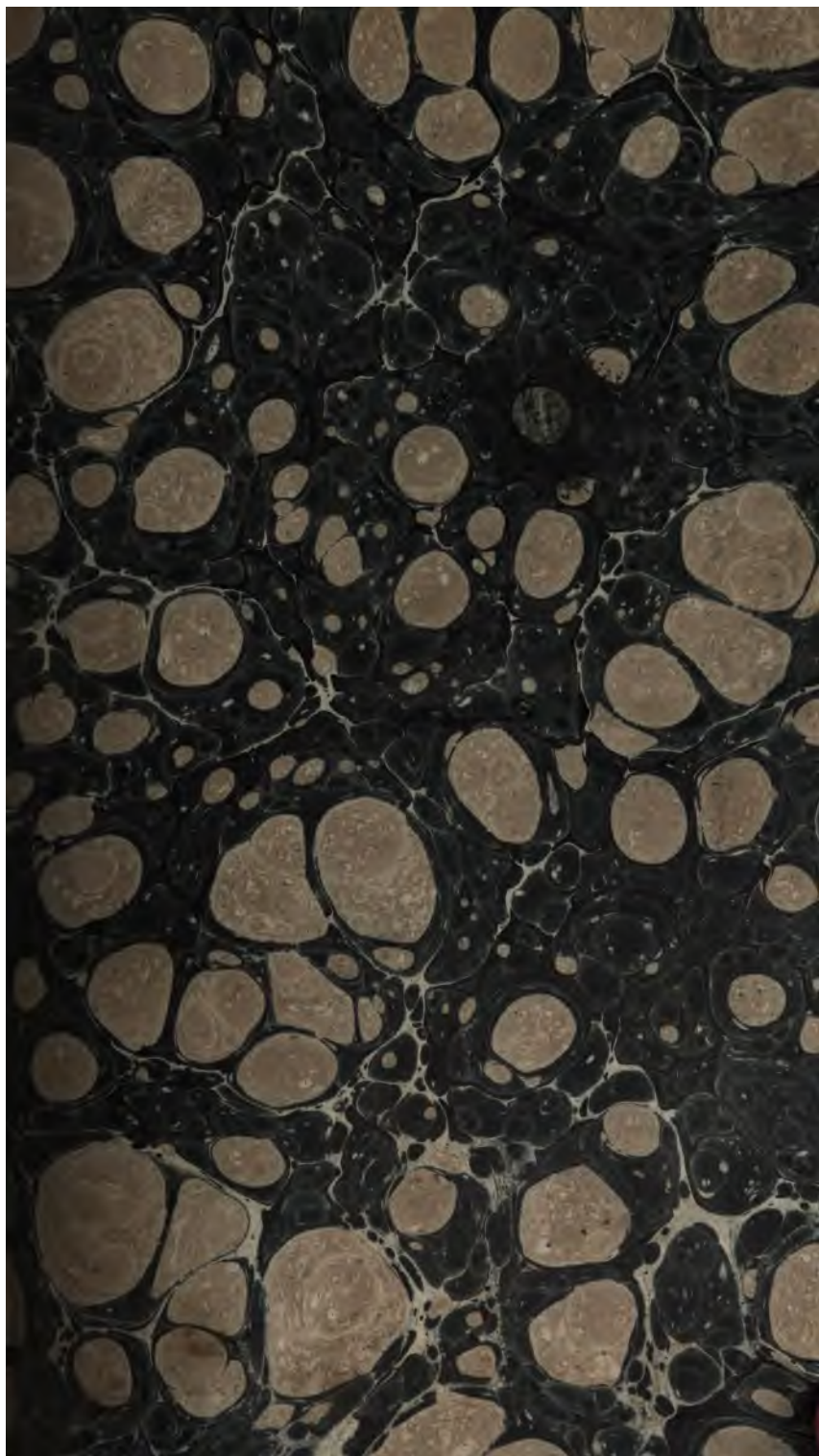
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TREATISE
ON THE
ORIGIN, QUALITIES, AND CULTIVATION
OF
MOSS-EARTH,
WITH
DIRECTIONS FOR CONVERTING IT INTO
MANURE.

PUBLISHED AT THE DESIRE, AND UNDER THE PATRONAGE
OF
THE HIGHLAND SOCIETY.

By **WILLIAM AITON,**
WRITER IN STRATHAVEN,
AUTHOR OF A FORMER TREATISE ON THAT SUBJECT; OF THE
SURVEYS OF THE COUNTIES OF AIR AND BUTE, FOR
THE BOARD OF AGRICULTURE; &c. &c.

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DEDICATION.

TO THE HIGHLAND,

OR

AGRICULTURAL, SOCIETY

OF

SCOTLAND.

MY LORDS AND GENTLEMEN,

AN anxious desire to procure for my former Publication on Moss-EARTH a respectable patronage, at first emboldened me to dedicate that tract to you. The union of high rank, extensive property, and animated talents, by which you are distinguished, the patriotic zeal you have displayed in promoting every species of national improvement, and the cultivation of Moss-Earth in particular, (a subject which heretofore had met with but little regard,) have raised you deservedly high in the estimation of your countrymen; and these considerations inspired me with the hope, that, under such auspices, my humble labours, which otherwise might have remained in obscurity, would perhaps be brought into notice, and rendered useful to the public.

NOR has that hope been disappointed. The patronage which I solicited you had the goodness to grant, and it proved at once, the earnest of flattering success, and of subsequent improvement. The first Edition of the book, and a small Manual since published, giving directions how to labour and crop Moss-earth, have both sold rapidly, and under the generous encouragement which you held out to me, I proceeded to prepare another edition for the press.

But a considerable enlargement of my new speculations has of late taken place. I have visited the principal Districts, both in England and Scotland, where the culture of Moss has been successfully carried on. I have travelled between two and three thousand miles, in order to examine such interesting experiments, and carried on an extensive correspondence with those by whom these experiments have been made; and thus, from all these causes, the growth of my materials has been such, as to render the present publication almost entirely a New work. Taking a wider range than most of the writers who have preceded me on the same subject, I have spared no pains on my part, to make it both a theoretical inquiry founded on rational principles, and a useful Manual for reducing those principles to practice.

TO contribute, although ever so inconsiderably, towards an object of such magnitude and interest, as the reclaiming of those extensive districts, which lie covered with Moss-earth in this Island, is an object of laudable ambition. To have obtained, in such an attempt, the approbation and patronage of the AGRICULTURAL SOCIETY OF SCOTLAND is my chief pride. It only remains for me to add the hope, that this Treatise (enlarged and improved as, I trust, it is) may be found neither unworthy of the importance of the subject, nor of the distinguished patronage, under which I am permitted to usher it into the world.

I have the honour to remain,

MY LORDS AND GENTLEMEN,

Your most obedient and

Much obliged servant,

THE AUTHOR.

STRATHAVEN,
1st August, 1810.

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PREFACE.

FEW Writers ever published, on any subject, under greater disadvantages, or with more diffidence, than the Author of this Treatise felt at the time he submitted his former Publication on Moss to public inspection.—The importance of the subject treated of—the little attention that had been bestowed on it—the want of Publications to suggest ideas on the subject—the erroneous notions of some, and prejudices of others—a sense of his own incapacity for such an undertaking—unreasonable opposition from some, and the want of aid or countenance from any quarter, seemed to stand as insurmountable obstacles in his way. But an ardent desire to rouse the attention of his countrymen to a subject, which he conceived to be of high importance, but which they had strangely overlooked, outweighed with him every other consideration; induced him to brave every difficulty, and to lay his thoughts on that subject before the public.—The notice that has been taken of that publication by many Noblemen and Gentlemen, the best qualified to appreciate its merits, and particularly by the Highland Society of Scotland, has been to him extremely gratifying, has removed his fears, rendered opposition abortive, inspired confidence, and amply compensated his labours.

It would give the Author much real concern, if any part of this publication should be found to be unworthy of that patronage under which it is published. But if any thing improper should have found a place in this,

Treatise, the blame and discredit it might occasion would only attach to himself, and not to his patrons, who, though they have approved of the general scope of the book, are not accountable for the errors the Author may have committed.

His attention was accidentally drawn, at an early period of life, to the subject of which he treats, and he has ever since continued the study with unremitting ardour. Like many others, he at first entertained notions on the subject, which more cool reflection and due attention to the processes of nature, have shown to be unfounded and absurd. Impressed with the strongest conviction that Moss-earth was a description of soil capable of being cultivated to great advantage, he eagerly sought for evidences to establish the fact: not on mere conjecture, but on repeated and well conducted experiments, where deception could not mislead, nor imagination betray. He had seen daily, for more than twenty years, the modes of cultivation practised on the moss of Strathaven, within half a mile of his own house; made many experiments on a small piece of moss which he occupied himself; surveyed often, and at all seasons of the year, the principal improvements attempted on that description of soil, in the Southern and Western parts of Scotland, and conversed much with those who had conducted such improvements, before he ventured to submit his opinions on that subject to public inspection. To obtain still further information on that important subject, with a view to communicate it to the public, he has, since he first published, travelled not less than between two and three thousand miles, for the sole purpose of surveying mosses that have begun to be cultivated, and discovering how the operations had been carried on, and what success had followed. His sole object

PREFACE.

in making these researches, with such labour, being to acquire the most correct information of what had been attempted, and to enlarge his own ideas on the subject; he took every opportunity of conversing with the cultivators; stating to them his own opinions, hearing their remarks, and taking notes of what was communicated to him. He has carried on an extensive correspondence on that subject, with the most intelligent and experienced cultivators in Scotland and England, put such questions to them as to him seemed doubtful, or had been controverted; solicited their best advices; inquired into every circumstance; and drawn his own conclusions.

He has been equally diligent in his inquiries into the Botanic productions of moss-earth, and the changes which these plants undergo in the course of putrefaction; the manures that act most powerfully on that description of soil, and the plants that thrive best on it when brought under a partial or more complete cultivation. He is sorry that his exertions have not been crowned with greater success. The publication will still be found to be far from having attained that perfection he so ardently wished it should possess. But when the subject shall have attracted more general notice, when proper experiments have been made on moss soil, and men of greater erudition and abilities have begun to pay attention to the subject, discoveries of much greater importance may yet be made, and more correct ideas formed on the qualities and uses of moss-earth.

To have detailed all that he has seen, and that has been communicated to him; or to have published all the notes he has taken on the subject, would have swelled this treatise beyond due bounds, without conveying in it more interesting information than it contains.

But the opinions he has adopted, and the doctrines he has taught in the following sheets, are founded on the information he has thus obtained; and that others may be enabled to judge for themselves, he has selected a few of the most spirited, best conducted, and most successful operations in moss culture, that he has been able to trace out in different Counties in Scotland and in England. These are faithfully detailed for the information of such as may attempt to improve moss ground, and to induce others to imitate the example of the most spirited improvers. These he trusts will prove the most useful parts of this publication. They serve to show that cultivation of moss does not rest on conjecture, but that it has been carried into effect in many instances to great advantage. They will also serve as patterns to other cultivators.

The singular appearance of moss-earth has given rise to many conjectures as to its origin. Some of these are so repugnant to common sense, and to every principle of sound philosophy, that the Author considered it necessary to notice and refute them. Speculations no less extravagant have been offered as to its qualities, and many improper directions given how to proceed in reclaiming it. Most of those who have written on the subject have thought it necessary to refute theories which they conceived to be extravagant, and practices which to them appeared erroneous.

An Author who has lately written on that subject, indeed pretends, for the sake of brevity, to avoid all comment on the writings of others, which he is pleased to term "unprofitable discussions." Yet without naming the Authors, he controverts occasionally the principles of the most judicious. One of the Reviewers of the first publication, attempts to sneer at the references

which the author had made to the writings of others. The author, however, does not consider such "discussions," when conducted with propriety, as "unprofitable." On the contrary, he views them as highly interesting; and neither the opinion of the one, nor the sneers of the other, have deterred him from pointing out such errors in theory or practice, as he had been able to detect. He considers it to be more manly to avow, than to disguise his plan. He had no wish to assume the character of a critic; nor has he acted from vanity or petulance, but for the sole purpose of refuting errors which he conceived were calculated to mislead the cultivator.

On subjects so little attended to, and so imperfectly understood, as those of the origin, qualities, and uses of moss-earth, it cannot be expected that even those who have paid the strictest attention, should be able to see every thing in the same point of view. Such unanimity of sentiment is not to be met with on any subject; much less on one where few experiments have been made, and of which our knowledge is so extremely limited. Few things in Agriculture can be reduced to Mathematical certainty. The diversities of soil, situation, climate, seasons, and other relative circumstances, are so great, as to prevent any thing in that noble art from being brought to rest on the solid basis of fixed principles. Were these causes less numerous, yet such is the diversity of opinion of the most intelligent, as to the causes from which good and bad crops proceed, that it is vain to expect the opinion of any one should in all things coincide with that of all other men.

Such diversity of opinion, however, does not preclude fair and candid discussion, nor render such discussion "unprofitable." On the contrary,

it renders it highly proper and necessary, provided it be conducted with temper, becoming decorum, and due respect to those whose opinions are controverted. The Author trusts he will not be accused of having treated unhandsomely any Gentleman to whose writings he may have referred. He considered it his duty to expose, with freedom, some of the theories of Dr. Anderson, which to him appeared extravagant. But he trusts he has at the same time treated that very respectable and intelligent author, as a Gentleman and a Scholar. A belief that the Doctor was not himself sincere in some of the propositions he has made, as to the origin of mofs; but that he was amusing himself with "*a jeu d'esprit*" or with "throwing out a few hints for the recreation of wranglers," as he says, induced the author to treat him with more severity than he would otherwise have done. The subject appears to the Author, of too much importance to be treated of with sportive levity.

In treating of the various subjects embraced in the publication, it has been the ardent wish of the Author, to point out with fidelity the mistakes in theory and practice, which either himself or others have fallen into, and at the same time to show, with all the judgment he possesses, and knowledge and experience he could collect from others, how he conceived such errors could be rectified.

In tracing these to their various sources, he has, to the best of his judgment, and with freedom, pointed out the share of blame which to him seemed justly attachable to the highest, as well as to the lowest ranks in society. The inattention of Government to a subject of great national importance; the perverted taste of some of the great land holders, in pursuing baubles in preference to

things of the first importance to themselves and the community, and the ignorance, indolence, and prejudices of the peasantry, have been pointed out with equal freedom, and without the smallest reserve, on account of the diversity of rank.

The language he has used may appear unpolished, and too plain for a courtly ear. Those who have been accustomed to listen to nothing regarding their Estates, but the interested representations, and flattering tales of them by whom they are too often misled and deceived, may take offence at the plain and simple truths, which the Author has stated without much ceremony. His descriptions of their faults and errors, may appear to them to be drawn with too much freedom, and in colours too strong, and his reproofs may seem to be too pointed and severe.

He has no doubt, but some of those who contrive to live in power and affluence, by the inattention of their masters to the most important parts of their duty and interest, may be loud in their complaints against the Author, for the honest freedoms he has used. And as these Gentlemen generally claim the privilege of being prompters to their masters, in all things regarding their Estates, they may tell them that the Author is a seditious, discontented, troublesome fellow, wishing to render the Nobility contemptible, and degrade their rank, by looking after their own affairs, or having the smallest communication with any person, but their own agents, factors, land-grievances, or those that one or other of these Gentlemen has confidence in. This book may be represented by them, as an insolent attack on rank and dignity; a levelling publication. He has no doubt but to some of the first rank of proprietors, who have, in all things regarding their Estates, placed themselves un-

der leading-strings, he may become obnoxious, and meet with persecution as the reward of his painful labours.

He shall only say, that his highest ambition has been to instruct, not to please by deceiving. He wishes to promote the improvement of his country, and to rescue his countrymen, of all ranks, from the mistakes and prejudices into which they have fallen, regarding a certain branch of that Improvement. He has seen much to praise, and not a little to blame on the subject on which he has written, and he has done the one and the other, not to flatter the vanity, and rivet the prejudices of any description of men, but in the way that he trusts will be most conducive to public utility, and agreeable to the dictates of his own conscience. His wish has been (and he trusts he has in some measure accomplished that desire) to treat his superiors with the respect due to their rank and birth, and all others decently, and with candour. He had no friend to serve nor enemy to decry, and therefore could have no inclination either to applaud or condemn contrary to the dictates of integrity and truth. He has avoided, as much as possible, every thing like personalities; and where individuals have been named, or their errors in agriculture pointed out, it was not with the design to provoke or expose, but to correct, instruct, and reclaim. Nothing could be farther from his wishes, than to give the slightest ground of offence to any proprietor or possessor of land, great or small. Errors in the management of the soil, which is the common stock of all, it was his duty to point out, and he has done so with the strictest fidelity, and with all the judgment of which he was possessed. Viewing matters as they have appeared in his eyes, he must have been justly charged with want of discernment, or neglect in the

discharge of his duty, if he had said less than he has done.

The improvements which he has recommended are such as he trusts will be found to be not only practicable, but really useful; equally remote from the whims of extravagant proprietors, who despise every thing that bears the venerable name of antiquity, and the blind prejudices of the ignorant rustic, who can only trudge round in the beaten path in which he has been accustomed to move.

So few have hitherto paid attention to moss-earth, or treated of its origin, uses, and qualities, that the subject does not yet present itself in all the varieties of reference which it will assume, after it has been discussed by greater numbers. Hitherto the student of this branch of natural history and agriculture, finds little more to found upon, than the solitary suggestions of his own individual mind. When the Author had prepared his former publication for the press, he had only seen on that subject, some few hints in a treatise, published by the Earl of Dundonald, on the connection between chemistry and agriculture. A small pamphlet by Dr. Anderson, a description of the improvements at Swinridgemuir, and Lord Meadowbank's directions for converting moss into manure. The Essay written by Dr. Walker, only came to his hand, after he had finished his manuscript, and in time to enable him to throw in a few interpolations. The only publications he has since met with on that subject, are an Essay written by John Nasmyth, Esq. and some Essays by the Reverend Dr. Rennie, on the origin of moss-earth.

Practical and scientific knowledge require to be united in the investigation of the qualities of moss; and the uses to which it is capable of being converted.

Unfortunately that union of talents is not always to be met with among those who are interested in that study; or even in those who have written on the subject. The practical cultivator is generally ignorant of science, and often prejudiced against it; and men of science are frequently but ill acquainted with many facts and practices, a knowledge of which would lead to useful results. Neither are the greatest sages in science altogether divested of prejudices. Their knowledge is acquired in schools, and from books, but they are frequently too great strangers to practical operations, and the useful instructions which these convey. They trust to experiments, made in vials and flower-pots, which are but ill calculated to give just ideas of agriculture. Every thing with them is subjected to the test of what they consider to be scientific principles, and by far too little attention is paid to experiments made upon a proper scale. A competent knowledge in science, founded upon, and regulated by extensive practical information, on the broad scale of experimental husbandry, is best calculated to lead to useful results.

Dr. Anderson was probably more acquainted with theory and practice, than any who had written before him on the subject. But unfortunately, he has adopted a fanciful theory as to the origin of moss, to establish which, he has perverted his scientific knowledge and extensive practical information.

The Earl of Dundonald, and Dr. Walker, have both discovered much knowledge of science, but neither of them has had that practical experience which is so necessarily connected with that subject. Lord Meadowbank is conversant in science, and he is no stranger to agriculture; but he has had no experience in improving moss as a soil, and his attention has been chiefly directed to the uses of moss as a manure.

Mr. Nasmith seems to have acquired scientific knowledge ; and he was at one time a cultivator of moss as a soil, on his Estate of Drumloch : But he has long ago abandoned that description of improvement, on the broad scale of acres and fields, and restricted his operations to handfuls of moss in flower-pots, placed in his garden and offices, in Hamilton. These may amuse, but they give a very imperfect idea of the cultivation of moss in extensive fields in high situations. Example in the cultivation of moss, and in every other branch of husbandry, is much better than precept. A well cultivated field of moss, raised from a rent of sixpence to twenty or thirty shillings per acre, and eight or ten bolls of good corn, raised from an acre, which did not afford the fourth part of the subsistence of one sheep, would have much happier effects, and afford more convincing arguments, to the proprietors and possessors of moss, than thousands of the most successful experiments in pots and cups, however accurately detailed, or volumes written ever so correctly. The crops of grain raised before their eyes, would speak home to their feelings, and rouse them from indolence ; while the flower-pot husbandry will only excite their laughter, and rivet their prejudices. Too great a display of learning is but ill calculated to induce the farmers to engage in that branch of improvement. Learning is out of place when brought forward on these subjects. Example is the great thing wanted. That without theory and profound erudition may do good ; but the most correct theory without example is useless.

The Reverend Dr. Rennie has also shown, that he is conversant in science, and he has gone beyond all others in laborious research. His inquiries have not

been bounded by the ocean, but extended to every quarter of the world. In the Essays already published, he quotes, or refers to upwards of a hundred authors, the greatest part of whom are foreigners. Though his labours seem to have been those of the closet only, yet it is hoped that when he treats of moss as a soil, he will lay books aside, take the field, and shew that he is no stranger to experimental cultivation.

Although the Author has yielded to the request of his friends and patrons, to prepare another publication on the origin, qualities, and uses of moss, he does not by any means lay claim to that extent of knowledge, which he considers to be necessary, to enable him to do justice to the subject; or to be capable of bestowing on it, that profound and solid investigation, which it so justly merits. He has to lament the limited extent of his knowledge on scientific subjects; though he has been at much pains to add to the little he had formerly acquired. Neither has he cultivated much moss himself. All that he can boast of is, the unremitting attention he has paid for many years, to the different modes of cultivation carried on by others; and having traversed so much of the Island, since he first published on the subject, with a view to collect into a focus, and lay before the public, all the practical knowledge that could be obtained.

The Author is aware, that when his labours are examined with a critical eye, he will be detected in frequently repeating the same arguments, in different parts of the Treatise, and sometimes nearly the same words; as well as in some grammatical errors. Had he been able to have extended, with his own hand, as he intended, the copy for the press, he might have corrected some of these errors. He would certainly have

been able to have conveyed his ideas, in some parts of the Treatise, in fewer words, and more correctly. But having undertaken to Survey, and draw out an Agricultural Report of the County of Ayr, for the Board of Agriculture, at the very time he should have copied over this Treatise for the press, he was obliged to get part of the original draught copied over by his clerk, who being unacquainted with his ideas, could make no amendments except in orthography, and part of it has not been copied. The Author would not, however, have expunged all that may appear to be repetitions. The Treatise was not intended for the learned, but for the practical farmer; and, as the generality of that class of readers are but ill informed on the simplest things regarding vegetable organization, and the decomposition of vegetable matter, the Author conceived it to be necessary to treat of these subjects, in different Sections of the Treatise, that they might be the better understood, and more deeply riveted on the minds of those whose knowledge of them is so imperfect, though intimately connected with their profession and interest.

Some of his remarks on the decomposition of vegetable matter, the nature and qualities of manure, changes of herbage from the humidity of the soil, &c. may appear to be trite and common-place. The Author did not put them down as profound and original thoughts, or new discoveries which he had made, or as conveying information to philosophers; but as plain and simple facts, connected with the subject of which he treats; but to which, he believes, the operative farmers do not attend to or rightly understand.

The learned reader will find that the Author has not dived deep into science, or been so very ambitious as

some others, to display profundity, or write *secundum artem*. His sole object was, to instruct the common farmer in the things necessarily connected with the subject of which he treats, and to dive no deeper into science, than that body of readers are willing to study, and qualified to understand. Grammatical inaccuracies will not be much noticed by those for whose use the Treatise has been written. The learned world will not consider such a publication worthy of their notice; or if they do, they will probably concur in opinion with the Author, that time is more usefully employed in stating an important fact, than in rounding a period.

In such a publication, on such a subject, and from such a pen, the Author trusts the public will not expect rhetoric to admire, or eloquence to applaud. Being neither possessed of such endowments, nor having leisure to cultivate them, he has directed his views to nothing but simplicity and truth. Technical terms, which so many writers on Agriculture seem to delight in, have been as much avoided as possible; and when introduced (as in the Botanic names of the plants or otherwise) they have been explained so as to be understood by the common reader.

Should it be demanded of the Author, have you gratified the expectations of the public? Have you thrown new and beneficial light on the important subject of which you treat, hitherto much involved in obscurity? Have you given that information which curiosity demanded, reason suggested, and fancy seemed to require? He would answer, that he knows too well the limits of the human understanding, and the narrow bounds set to his own, to have the arrogance to answer in the affirmative, to any of these interro-

gatories. Wide as has been the range he has travelled in search of information, and diligent as his inquiries have been, very much must have escaped his observation and most ardent research. The want of useful books, imperfect knowledge of science, and seclusion from improved associations, have restricted him, in a great measure, to the solitary suggestions of his own mind.

His greatest ambition has always been, and still is, to draw the attention of others better qualified to do justice to the subject, and if possible to direct the attention of proprietors and possessors of land, to a matter that so much concerns them and the public.

The Author can have no individual interest in the subject of which he treats, beyond that which every member of the Commonwealth must have, and feel, in what they conceive to be matters of general interest.

It was a conviction in his own mind, that the improvement of Moss was of national importance, that first induced him, under so many incapacities and disadvantages, to publish his thoughts on the subject. Matters still appear to him in the same point of view. If his powers of persuasion bore any proportion to the ardour of his zeal, he would proclaim to all ranks, the advantages to be derived from the improvements he recommends, until it was understood and practised from one end of the kingdom to the other.

Whatever good may result to the public from his labours; whether the subject of which he treats shall ever appear to others in the same light it has done to him; whether he may ever live to see any of the deserts of his native country begun to be converted into fruitful fields; or if he shall never realize the most ar-

dent wish of his soul, nothing can deprive him of the consolation of having done all that was in his power, and that in the most disinterested manner, for the public good.

A TREATISE
ON
MOSS-EARTH.

INTRODUCTION.

MANKIND are often solicitous about matters of small value, to the neglect of things of much greater consequence. This is the case in what regards agriculture; a science of the greatest importance, but the prosecution of which has hitherto been left, in a great measure, to the poor and the illiterate. Some branches of that noble art have begun to be investigated with considerable care, but others have not certainly been yet attended to in any degree suitable to their great importance. The substance to the consideration of which this Treatise has been devoted, sufficiently proves the truth of these remarks.

A very large proportion of the surface of Scotland, and many thousands of acres in different counties in England, which were at some former period rich and fertile, or at least were as capable of being rendered so as any of the land in their neighbourhood, are now unfortunately covered with moss earth, which has hi-

ther to been considered of little or no value as a soil, and is well known to be otherwise injurious. Yet, though that substance is still increasing in depth, wherever it has fixed its seat, and continuing to extend itself over more of the surface in all neglected spots, very little attention has ever been paid to that intruder. Many are so ignorant of its nature, as not to know that it has increased, or is still increasing, even in depth where it already exists, or over more of the surface any where; and of those who have noticed its accumulations, few have made the least attempt to intercept its growth. Scarcely has an inquiry been instituted how its progress might be arrested, the surface it has enveloped recovered, or to what useful purpose the moss itself is capable of being converted.

The intrusion of Moss earth has been attended with two evils of great magnitude; 1st, the loss, or at least the reduction, of the value of an immense extent of soil; and 2dly, its pernicious effects on the atmosphere.

1. The extent of surface in Scotland alone now covered with Moss-earth, is so great, and the exact amount so ill to be ascertained, that it becomes difficult to offer any estimate on the subject.

As no actual survey has been taken, we must rest satisfied with well founded conjecture, approaching to the truth, as furnished by the Board of Agriculture, from the County Reports, and such other documents as they could procure.—From these it appears, that there are of waste land,

In England	.	.	6,259,470 acres.
In Wales	.	.	1,629,307 do.
In Scotland	.	.	14,218,224 do.

Total 22,107,001 acres.

INTRODUCTION.

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Some part of that in England is not covered with moss, but those in Scotland are wholly covered with that earth.—The extent in each county is as under :

	Acres.
Aberdeen, unimproved lands, -	374,400
Argyle, wastes and mountains, -	787,733
Air, moorish wastes, - -	318,454
Banff, wastes and hills, - -	290,000
Berwick, moor and moss, - -	126,000
Bute and Hebrides, moors and wastes,	2,888,000
Caithness, wastes and commons, \	368,000
Clydesdale, moors, - -	250,000
Clackmannan, wastes and moors, -	25,000
Dumbarton, wastes, - -	164,266
Dumfries, wastes and commons, -	200,000
Elgin, wastes and commons -	250,000
Fife, hill-moss, &c. - -	64,000
Forfar, wastes in English acres, -	71,875
Inverness, 5-6ths of all the surface,	1,694,933
Kinross, wastes, - -	25,000
Kirkcudbright, 2-3d waste English acres,	266,734
East Lothian, wastes, - -	55,000
Mid Lothian, 1-3d waste, - -	75,800
West Lothian, wastes in English acres,	14,333
Mearns, wastes and commons, -	164,266
Nairn, do. do. - -	10,000
Orkney, do. do. - -	700,000
Perth, wastes *, - -	1,321,600
Renfrew, wastes, - -	24,533
Ross and Cromarty, wastes, -	1,480,000
Roxburgh, heath and hill pasture,	250,000
Selkirk, wastes and commons, -	145,000
Stirling, do. do. - -	120,000
Sutherland, do. do. - -	1,232,000
Tweeddale, do. do. English acres	169,360
Wigton, moorlands, - -	198,134

Total in Scotland, 14,218,224

* There must be some error as to Perthshire. The total of Acres in that County is 4,068,640, and as 5-6th parts of the whole is waste land, the amount must be 3,890,580, almost three times what is stated above.

To any person who has traversed these counties, it will not appear that the foregoing calculations are over-rated, but the reverse. In the counties of which I possess the most complete local information, I am confident the extent of moor ground is by far under-rated. Mr. Nasmith computes the mosses in the middle ward of Lanarkshire at 42,000; but, I have resided twenty-six years in that district, and been many times on every farm in it, and in the whole county; and I am confident that twice that number of acres, on the middle ward of Lanarkshire, is covered with moss. A much greater proportion of the upper ward is buried under that earth: The proportion of surface covered with moss-earth, in Clydesdale, is much greater than it has been represented by that intelligent surveyor.

Vast ranges of all the neighbouring counties are buried under the mossy turf. A person may travel on that description of soil, from the banks of the Clyde, in Renfrewshire, to the shores of Galloway, one hundred miles distance; or from the banks of the Forth, to the borders of the Irish Channel. In many places in both of these courses, the mosses run with little interruption, more than twenty miles, in a transverse direction. Following the course of the ancient forest of Selkirk, the greatest part of the soil is covered with moss, from the Lammer-moor-hills to the shores of Carrick. If we set our face towards the north from the Clyde, or the Forth, mosses innumerable, and of unknown extent, every where present themselves to our view. Not only are immense tracts of the counties of Argyle, Perth, Inverness, Ross, and Sutherland, which are mountainous, covered with moss, but it also abounds in the counties that are more fertile.

The Shetland Isles, the Orkneys, and Hebrides, all groan under moss. It is found not only in every shire, but more or less in every parish, and frequently on every farm, from Kintyre to St. Andrews, and from Caithness to Kirkcudbright. The most extensive range of moss that I know in Scotland, is at High-bridge, north of Fort-William, and from the King's-house on the Black Mount, looking north-east. I have only seen part of this moss myself, but from what I have seen, and been told by Dr. Robertson, the intelligent surveyor of Perth and Inverness shires, I believe it is by far the most extensive moss in Great Britain.

The Rev. Dr. Rennie has mentioned many mosses, both in Britain, and on the continent of Europe, that are of great extent; Hatfield moss alone, he says, contains 180,000 acres; one on the Shannon is fifty miles in length, and two or three miles broad. The Bog of Allen contains 300,000 acres. It has been stated to the Board of Agriculture, that there are 150,000 acres of unimproved fens in the county of Cambridge; which, by a moderate improvement, would yield 10s. per acre, or 75,000l. per annum. Dr. Rennie taking this county as the seventieth part of England, and supposing as much moss in every other part of the kingdom, calculates on a yearly rent to be raised from cultivated fens, to the amount of ten millions sterling, which at thirty years purchase, would add three hundred millions to the national capital. The Rev. Author is not correct when he supposes that every county in England contains as much fen as that of Cambridge: the price which he sets on the cultivated moss is only ten shillings per acre, whereas if done with propriety, it may bring at least four times that

rent, so that his calculations are not upon the whole too high. If that sum could be added to the capital in England, what might not be effected in Scotland, where there is still a much greater proportion of moss?

Such extensive ranges of the country in all parts of Britain covered with moss earth, is (independent of its effects on the climate) a serious privation.

In some places the moss rests on a subsoil of small value, being rocky or otherwise incapable of cultivation, or situated in altitudes too high for the growth of grain. But this is not the state or situation of all the soil that moss now covers: Many thousands, and hundreds of thousands of acres of moss, rest on extensive plains, haughs, and vallies, where the subsoil is composed of clay, or loam, which once produced trees of vast size, and the richest herbage; and which, if the moss were removed, is still equal in value to the best land in the neighbourhood.

This useless state of so much of the soil, once so valuable, is a privation much to be regretted. If that accumulation had been prevented by relieving the surface of all stagnant water, or if that encumbering moss could now be removed, some millions of acres would be thereby added to the productive parts of the Island; the food of man would be increased, and of course the population would be multiplied. But the loss of many millions of acres of the soil, is not the only evil resulting from the accumulation of moss, over the surface of so large a portion of Britain.

2. The immense loads of moss that have grown over the surface, have very much injured the climate, and thereby rendered every other part of the soil, even where no moss rests, much less productive than it

would have been, if moss-earth had been collected in its vicinity; other relative circumstances being the same.

In my former publication, I hazarded an opinion, that the climate of Britain was colder now than at the time the Romans held dominion in this Island; and that that change in the temperature, was chiefly owing to the accumulation of moss over so much of the original soil. In support of that opinion, I quoted authorities, and pointed out facts which appeared to me to be conclusive.

It seems to me abundantly evident, from the writings of the Roman historians, as well as from the poems of Ossian, that the climate of Britain was, at the time they wrote, mild, though not serene. The climate in Gaul was so excessively rigid, as to be proverbial at Rome. *Cæsar* (de. Bel. Gal. l. v. c. 12.) says expressly, that the climate in Britain was milder than that of Gaul. *Tacitus*, who lived six years in Britain, and traversed every part of the Island, corroborates the account given of the climate by *Cæsar*. It was loaded, he says, with vapour, and obscured with clouds, (Vit. Agric. c. 12.) The many beautiful allusions made by Ossian to the mists, fogs, and clouds of Caledonia *, corroborate

* The Reviewers in the Farmer's Magazine, vol. vii. page 93. say, "We suppose the Author would not *now* have quoted the authority "of Ossian's poems, for the state of the climate, or for any other "matter of fact." But with all deference to that valuable publication, and the very respectable Reviewers; and, much as I admire the classical and moral purity of Johnson, and the elegant style, and diligent research of Malcolm Laing, Esquire, my belief in the authenticity, and remote antiquity, of the celebrated poems of Ossian, remains unshaken. Making allowance for the latitude taken by poets, I consider the authority of Ossian, as no way inferior to that of any of the Greek or Roman classics.

the accounts given of the climate, at that period, by the Roman historians.

Dr. Halley has shown that Cæsar landed in Britain on the 26th of August; and Cæsar himself informs us (de Bel. Gal. lib. iv.) that the harvest was then finished, except in one field. *Diodorus Siculus* says, "Such, in a word, is the excessive severity of the winter, and the piercing coldness of the air, in Gaul, that it produceth neither vines nor olives." (Lib. v. sect. 25. and 26.) None of the Roman historians give such an account of the climate of Britain. *Tacitus*, (Vit. Agric. c. 12.) indeed informs us, that it did not produce vines or olives, but it was fit, he says, for all kinds of forest trees, and all other plants and vegetables, except a few that were peculiar to the hotter countries. But after the Romans had become better acquainted with the country, and had meliorated the climate by cultivating the soil, they found it to be capable of rearing vines, and they accordingly obtained liberty, Ann. Dom. 278, from Probus the Emperor, to plant vineyards, and make wine from them in Britain. (Scriptores Hist. Aug. p. 942.) *Bede*, an early historian, the Doomesday book, Records of the Monasteries, &c. all prove, that wine was made in Britain, even after the departure of the Romans. And many places in England still bear the names of Vineyards.

These historians have not indeed pointed out the degrees of heat, or the density of the air, on graduated scales of the Thermometer and Barometer, which are modern discoveries. But they have established historical facts sufficient to enable us to draw conclusions by fair analogy. By pointing out the comparative degrees of heat in Britain and in Gaul, they make these

countries serve as Thermometers to each other. They inform us, that the climate was colder in Gaul than it was in Britain; that the former country produced no grapes, but the latter yielded grapes and wine.

But the alteration in the climate in these countries does not rest solely on the authority of history; it is proved by facts still visible to all.

Trees of enormous dimensions have grown spontaneously in many parts of Britain, where it would baffle the ingenuity of man to rear a tree to the tenth part of the size. The mosses in all parts of the island abound with trees of much greater dimensions than any now to be found growing in this country. The late Mr. Browning found an oak tree under a moss in his lands of Benthall, in East Kilbride, of such size and preservation as to floor a Garret twenty feet long, by sixteen wide. The boards, more than one inch in thickness, may still be seen at Benthall. Another oak tree may be seen there upwards of sixty feet in length. It has evidently been broken at both ends, and the lower end not being completely covered with moss, has rotted so much, that the dimensions of the tree cannot now be ascertained, but the upper end is more than four feet in circumference.

At Thriepwood, in Dalserf parish, and county of Lanark, the trunk of an oak tree, sixty-five feet in length, was a few years ago dug from under moss. It was as straight as the mast of a ship, and so equal in thickness at both ends, that it was not easy to say which was the root. Both these trees had grown at five hundred feet of altitude, above the level of the Sea, and on ground on which it would be difficult to rear an oak to the twentieth part of the size.

Many fir trees a hundred feet in length have been

found under moss. But what is still more surprising, oak trees a hundred feet long were found on draining Hartfield moss in Yorkshire. They were as black as ebony, and some of them sold a hundred and fifty years ago as high as 15*l.* for one tree. One oak tree was dug from under that moss, which measured 120 feet in length, twelve feet diameter at the root, and six feet diameter at the top! Twenty pounds sterling was then offered for that single tree. One of the same dimensions, with its bark, would sell now at three hundred pounds; but no such tree at present exists in Europe.

The climate in Britain was milder than that of the Continent, and the trees in the former were larger than those in the latter. When Archimedes built, about 2000 years ago, a ship of dimensions then altogether uncommon, he could not find on the shores of the Mediterranean, a tree fit to be its main-mast, but was obliged to commission one from Britain. It was cut and carried to the sea coast, on a machine invented by one Philias Turriamentus, and being transported to Syracuse, it became the main-mast of that wonderful vessel.

Trees of such dimensions do not now grow in Britain. Some of the oaks in Hamilton Park, or that were lately cut there, were nearly as thick as the generality of them that are found under the mosses. But these are not modern oaks. They are the trees "of other times," which have not been destroyed by the rude hands of our ancestors.

Some have argued, that the extraordinary size of the trees found under moss, proceeds from their having grown in a forest, under shelter of each other. But all the advantages which a tree can derive by growing

in a forest is shelter, and one growing in the centre of a wood, of fifty or a hundred acres in extent, is as completely sheltered as if the forest were many miles in extent; especially on ground so uneven as the generality of that in Scotland. We have still some woods and forests that are several miles in extent; but we do not find that the trees in the centre of any of these are larger than those nearer the verges of the wood.

But the climate was then also more congenial to the growth of fruits, grapes, &c. as we have seen, and also of grain, than it is now. The records of the religious houses show, that wheat was paid as a tythe from lands, on which human industry could not now raise that species of grain. Wheat was paid annually as a tythe to the priory of Lesmahagow, from lands in that parish, on which that species of grain has not been sown for several centuries past, and where it could not now be raised; where under the present economy, oats can scarcely be brought to perfection. The minister of Glenluce, in the Statistical Account of his parish, mentions a farm that paid to the monastery of Glenluce, twelve bolls wheat, and the same quantity of Barley, as a tythe. But such is the melancholy alteration, that, about thirty years ago, that very farm was set at 12l. of yearly rent. Similar instances might be pointed out in many parts of Scotland.

The marks of the plough on the highest hills, "not like a slight attempt rashly undertaken, and quickly abandoned, but like that of fields that have been for a time under active culture," (Nasmith's view of Clydesdale) prove to a demonstration, that the climate must have been much milder in former ages than it is at present. No human power could now raise crops of grain in such situations.

The diminutive size of some of the wild animals, and the decreased number of sheep, cattle, or other stock, which can now be supported on our muirs and commons, compared with what it appears from the charters of the proprietors they once maintained, all show that a melancholy alteration has taken place on the climate.

It is needless to argue that the sheep are either better fed, or of a larger size than those which pastured these muirs in former ages. The domesticated cattle are better fed, and the breed improved, but the poor mountain sheep are the same as formerly, and unless the *quality* of their pasture be improved, they must remain as they are. If heath, fog, ling, and such herbage were the food which could support an improved breed, there is no want of such plants on our muirs. But the change of climate, and increase of moss, has banished, or greatly diminished the rich herbage, and left little growing but the plants which sheep cannot eat.

In whatever light these proofs may appear to others, to me they establish, in the most satisfactory manner, that a material alteration has been effected in the temperature of the climate, since the departure of the Romans from Britain.

The authorities I have quoted, and the facts I have pointed out, show that the climate has undergone, in Britain and in Gaul, a material alteration since the Augustan age. Britain, during the residence of the Romans in that island, bore vines, and yielded good wine, while neither vines nor olives could be made to grow in Gaul. At present vines and olives grow in France, in the open air, but can only be reared in Britain by aid of a hot-house. Then the climate in Bri-

tain was milder than that of Gaul. Now the climate in Gaul is milder than in Britain. These facts are incontrovertible. The causes from which they proceed are subjects worthy the investigation of Statesmen, and men of science.

In both countries the climate must have been rendered milder by cutting down the forests, draining the marshes, improvements in agriculture, and the processes of combustion, and animal respiration, greatly multiplied by the increased population, and improved condition of society. But powerful as these effects have been, their influence must certainly have been counteracted, in Britain at least, by something that has had an opposite tendency. It is evident that these have not operated with equal power on both sides the channel. It would be desirable to trace the causes of these changes.

When extensive tracts of a champaign country are overgrown with trees of a large size, the heat of the sun is prevented from warming the earth, this privation must keep the temperature much lower than it would be, if the solar rays had free access to the soil. This must have been the case in ancient Gaul, which is a level country, and was much covered with forests. The same thing happens in America. Hence the climate is more severe in the woody parts of that country than in parallel latitudes on this side the Atlantic, where the forests have been cut. But in Scotland, and in some parts of England, the surface is so uneven, that all the trees which grow on the hills and steep banks, would never so completely exclude the heat of the sun, as in the level plains of France. All the trees which could be raised on some parts of Scotland would rather mend than injure the climate.

The difference of the climate in ancient Gaul and in Britain, may have in part proceeded from that cause. In the former, the heat of the sun was excluded from the earth, while in the latter the trees did not so much injure the climate. Of course the cutting down of the forests in France, would improve the climate; while in Britain that operation, in the way in which it was executed, would increase the cold.

Some trees are necessary to shelter the ground, and, when they are not too numerous, they render the country much warmer. In France, such a number has been preserved, but in Scotland, where a still greater number were necessary to screen the bleak hills, scarcely a tree has been left standing. The hills and mountains are entirely divested of the ornament and clothing which nature has provided for the earth.

In France, the forests were cut down to extend the range of cultivated soil. But in many parts of Britain the trees were cut down and left to form mosses. Gaul is a level country, and in its natural state would abound with marshes, the draining of which would improve the climate. In Britain, and especially in Scotland, the surface is so uneven, that fewer marshes would ever exist, and the climate has not been improved by that operation so much as that of France.

The greatest part of Scotland, and extensive ranges of England, are mountainous, unimproved, and but thinly inhabited. These mountains have a tendency to create strong currents of air, condense and break the clouds, attract the electrical spark, and occasion torrents of rain. Their hoary heads, some of them covered with perennial snows, are no way propitious to a high temperature. Neither will the increased combustion, animal respiration, or improvements on the

foil, supposing them to have been equal in both countries, raise the temperature so much in an island, as they would do on a large continent.

Britain, though a large island, is but like a speck in the extensive oceans with which it is surrounded. Agricultural improvements, or whatever might have a tendency to increase caloric on such a small spot, can never raise the temperature much higher than that of the surrounding ocean. If the temperature of a small island should be raised ever so much, the currents of cold moist air would fly from the ocean, on the wings of the wind, and bring the atmosphere nearly to an equilibrium with the temperature of the surrounding seas. On the other hand, if any thing in a small island should have a tendency to diminish the temperature below the medium of the surrounding atmosphere, that power would be counteracted by that tendency which nature has placed in heat and cold, to come to an equilibrium. But if the causes of increased or diminished caloric, should extend to an immense continent, the counteracting effects of the ocean would not operate with equal powers.

It was probably owing to this circumstance, that the climate in Britain was, in former ages, milder than that of France. It could not then be lower than that of the surrounding seas, while in Gaul the temperature would be regulated by that of the immense continent of which it formed a part. The temperature of Britain, and especially the northern parts of the island, can never be raised much higher than that of the ocean. Whatever improvements may be made on the island, there can be none on the ocean, and therefore, the climate will not be regulated by the temperature of the land, but by that of the sea. The

flame issuing from Mount Hecla does not alter the temperature of Iceland, and Etna is enveloped in snow to the mouth of the crater.

From these causes, it is obvious, that the increase of temperature, arising from internal improvements, has been counteracted, and that they have not operated so powerfully in Britain, as they must have done on the opposite side of the channel. But other reasons may also be assigned for the severity of the climate in Scotland, compared with what it was fifteen hundred years ago.

The immense loads of uncultivated moss, that have accumulated on the surface of so much of that country, and on some parts of England, must have had very powerful effects in lowering the temperature.

No other soil or substance is capable of taking in so large a quantity of moisture as moss earth. It is impossible to ascertain the quantity of moisture that a flow moss in its natural state will take in. Many of them are *semi-liquid*, or even more moist. When brought under cultivation, moss loses part of its capacity for retaining water. But even in that state, $32\frac{1}{2}$ ounces of dry moss soil will absorb and retain, *without fluidity*, 18 ounces of water, while 39 ounces of the richest garden mould, will only retain $18\frac{1}{2}$ ounces of water.

Moss is also much more retentive of cold * than any

* The Reviewers, in the Farmer's Magazine, take notice of a similar expression in the former Publication, and remark, that by it, and such like modes of expression, the Author would seem to consider *cold* not as a mere privation of *heat*, but as a positive quality. But as similar expressions are used, not only by writers on Agriculture, but also by Chemists, Philosophers, and Linguists of the first eminence, I have not been at pains to alter the sentence. The ce-

other soil or earth whatever. Moss not only takes in more moisture than any other soil or earth, but from its light, open, and pervious nature, it permits the frost to penetrate deeper, and it retains it longer than any other earth or substance whatever can do. The frost will often be found to be so little impaired, as to be strong enough to support a horse and loaded cart on a moss, when the plough is at work in the neighbouring fields: the frosty congelations, when the winter has been severe, will sometimes remain in the moss till after the middle of summer.

The exhalations drawn from such an immensely extended surface of damp, cold, torpid moss-earth, so much burdened with moisture, must be great beyond calculation; and the attraction which such surface must have for moisture, the rains it must occasion, and the cold it must generate, compared with any other soil, must be immense.

The rays of the sun, and the dry winds in spring and summer, must exhale an immense quantity of moisture from such immeasurable tracts of moss-earth.

celebrated Dr. Johnson says, in his *Lives of the Poets*, "No man scruples to say, that darkness hinders him from his work; or, that cold has killed the plants." Similar expressions are met with in the *best* of books. Darkness is no more a positive quality than cold: It is the mere absence of light, yet we have all read of "*Darkness*," "*Gross Darkness*," "*Darkness that might have been felt*." These expressions may be termed, "speaking after the manner of men," but not of critics.

Too much learning or profundity, is more likely to mar the usefulness of such publications as the *Farmer's Magazine* and this *Treatise*, than the greatest plainness and simplicity of style. Such books frequently contain too much learning for the description of Readers to whom they are addressed, and too little for scientific men.

Evaporation from any soil or substance, has a more powerful tendency to lower the temperature, than any other process of nature with which I am acquainted. A body in a fluid state contains more caloric than it does when solid; and if the same body passes into vapour, it will contain still more caloric than when it was fluid, without the temperature being in either case increased.

When any fluid is converted into vapour, a large quantity of caloric is absorbed from the atmosphere, or surrounding bodies, and kept and retained by that vapour in a latent state. The heat thus extracted from the earth, or atmosphere, by the moisture exhaled from the wet spongy and greatly extended mossy surface, must be immense; and, as it retains that caloric in a latent state, without in the least increasing the heat, even of that vapour into which it passes, it must greatly cool the earth and surrounding atmosphere. It is in this way, that moss-earth may justly be said to generate cold, or, what is the same thing, to lower the temperature. The exhalations from any other soil or surface, have in some measure, the same effects. But, as moss is itself colder than any other earth, the moisture exhaled from it must attract and carry with it a larger quantity of caloric than that which proceeds from a warmer earth. And, the moisture in moss being more abundant than in any other soil, and that earth more ready to part with it than any other earth, the exhalations from such an extent of surface must be immense, and the caloric it must attract, carry off, and keep in a dormant or latent state, must greatly cool the atmosphere, and lower the temperature.

It is also well known, that any spongy damp sub-

stance, attracts and assimilates moisture from the atmosphere, more powerfully than dry substances. The cold in the moss-earth condenses, and the moisture it contains attracts the aerial fluid. Hence we find that rain, and even dews, fall more copiously on moss ground, and in the vicinity of that earth, than upon or near a dry soil. These copious supplies soon overcharge the moss with moisture, and make it ready to furnish vapour, whenever the exhaling powers of the sun and winds are renewed. Thus it is, that moisture attracts moisture, and cold increases cold, beyond calculation.

When exhalations are so great and drawn from such huge and immensely extended bodies of damp spongy earth, at all times colder than ordinary earth, and but seldom divested by large bodies of congealed frost, it cannot fail greatly to lower the temperature of the atmosphere, and prove extremely injurious to vegetation in the surrounding fields, especially to such plants as require a high temperature to bring them to maturity. The cold issuing from the moss, must at all times tend to render the atmosphere colder, and to chill and benumb every vegetable over which it passes; and where the chilling damps are not broken and mixed with the common atmosphere, but kept together in a body, they poison every valuable plant on which they fall.

If such are the effects produced by moss, and if the greatest part of the mosses in Britain have been formed since the Romans invaded the island, (as will be shewn in course) I conceive myself warranted in ranking moss among those things that have contributed, and that in no small degree, to the rigidity of the climate. The temperature, I humbly apprehend, is much lower

than it would have been, had no moss-earth ever been collected over the original soil; or than it would still be, if that earth were either removed, or its nature changed by cultivation.

Whatever diversity of opinion may be entertained, as to the comparative state of the climate, now, and sixteen hundred years ago; whether it be warmer now, or more rigid; and whether the other proofs I have offered, of the alteration of climate, be as satisfactory to others as they appear to me; there can be no doubt that the vast accumulations of moss over so much of the surface, and to such great depth in many places, have had effects, and those very powerful ones, in rendering the climate much colder than it would have been, had no such substance ever been formed over the original soil. On this point there can be but one opinion. If so, too much importance can scarcely be attached to the subject of this Treatise. The accumulation has taken place, and cannot now be prevented. That earth can neither be annihilated, nor removed from the island. But it can be brought under culture, which would, in a great measure, answer the same end. Moss as a soil is capable of being rendered productive of grain, and of the richest grasses; and that improvement will meliorate the severity of the climate, and render the whole other ground more productive.

Having thus shewn the grounds of my conviction of the importance of the subject of which I am to treat, I shall first inquire into the origin of moss-earth, name its leading qualities, so far as the cultivator is interested, point out the various uses to which it may be converted, give directions for labouring, manuring, and cropping that species of soil, shew what has been ef-

fects in various parts of Scotland and England, and conclude with pointing out some of the principal bars which seem to stand in the way of that species of improvement, and the means by which these can be removed.

PART I.

AN INQUIRY

INTO THE

ORIGIN

OF

MOSS-EARTH.

THE first and most natural inquiry concerning moss-earth, will be to discover of what it is composed, and by what process of nature that singular substance has been formed over so much of the earth's surface. Such an investigation is equally worthy of the Agriculturist and the Philosopher, though hitherto unaccountably overlooked by both. The *uses* to which that or any other soil or substance can be converted; is, no doubt, the most important point to be investigated; but these will be best ascertained, by first tracing out the qualities which they possess; and in making that research, it must be of the utmost importance to discover of what the substance is composed, and how nature has proceeded in reducing it to the particular form and state in which it now appears.

The laws of nature, so beautifully displayed in the wonderful economy of vegetable organization, in the death of plants, and in their partial or more complete disorganization, are subjects worthy of the research of Philosophers and contemplation of divines. But it is more especially the business of those who cultivate the soil, to investigate these subjects, not merely for speculation, or to excite devotion, but as forming an important branch of that useful and honourable profession to which they belong. Every proprietor or possessor of land should not only be well acquainted with all the plants, useful or noxious, which grow on his fields; know what climate, soil, culture, and relative circumstances promote or retard their growth; what food each plant relishes, and the uses to which they can be converted; but also what changes they undergo, after their vegetable life has terminated. Whether they readily and spontaneously yield up the substance of which they are composed; how that decomposition may be accelerated or retarded; what are the new compounds into which they enter, and how these mysterious processes of nature can be rendered subservient to the important ends of agriculture. These are some of the most real and interesting concerns of an intelligent agriculturist. And in these there are also comprehended all that relates to the origin, qualities and uses of moss-earth.

On a subject so little attended to, and so imperfectly understood, it is not to be expected that even those who have made considerable investigation, should be altogether of one opinion. Hence we find, that many conjectures have been formed, and speculations entertained, concerning the origin of moss earth. As some of these have a tendency to mislead the public opinion, and to stand in the way of those improvements of which that description of soil seems capable, it becomes necessary to notice and refute them. A Reviewer of the former Treatise, cavils at this mode of arrangement, insinuates that I had exposed the opinions of others to make room for my own theory, and quotes some lines from Mr. Prior, to turn my arrangement into ridicule. I cheerfully submit all my opinions to criticism, and I have profited by them in some instances, and made correc-

tions ; but the propriety or consistency of these remarks I have not been able to discover, especially from a Clerical Reviewer, whose duty and daily practice it is to point out the errors and mistakes that others have fallen into, and who, in the discharge of that duty, generally follows the same *modos operandi* which he condemns in me, by showing *first, negatively*, what things are not, and *secondly, positively*, what they really are. But whatever others may think, to me that seems to be the best mode of arrangement in a treatise of this kind, and I beg leave once more to pursue it.

CHAP. I.

NEGATIVELY WHAT MOSS IS NOT.

SECT. I.

Moss is not of Antediluvian origin.

THE lower orders in society, whose study of natural history has extended no farther than the perusal of the Pentateuch, and who imagine that they can trace the marks of the universal deluge on the face of every hill, generally believe, that moss-earth is composed of the wood, grass, and other herbage, which existed on the face of the earth at the time that deluge destroyed the antediluvian world, and that that herbage had been laid in particular places by the flood. Dr. Morton, it seems, became a proselyte to that popular opinion ; but a slight inquiry into a few obvious facts, will be sufficient to shew its absurdity.

To spend time in refuting opinions so extremely absurd, and which every man of an ordinary degree of information would be ashamed to avow, may seem unnecessary. But absurd as that theory certainly is, as it is still entertained by the generality of that class of society for whose use and instruction this Treatise is published, and as, like other prejudices that are founded on false conceptions of religion, it stands, with many, in the way of every improvement on that description of soil, it falls to be refuted.

That knaves or impostors should, in times of ignorance, have imposed such cheats on mankind, and that some of the least enlightened of the peasantry, should still believe absurdities which they have sucked in with their mother's milk, is not surprising. But that any person who could read the Bible, should ever have attempted to found such an absurd prejudice on the sacred volume, is to me astonishing. We are there informed, that in the days of Noah, the whole human race, and every living creature then on the face of the earth, (with the exception of a few for which the Ark was provided) were drowned by the deluge; but it is not any where said, or implied, that any of the mosses now on the face of the earth, were collected by the waters. The story cannot be traced to the writings of Moses, but has originated in imposture, and is only supported by ignorance and credulity.

I should not have expressed my opinion in terms so strong, had I not been provoked at the stupidity of those who have become proselytes to that strange opinion. These are so numerous among the lower orders, that some of my friends advised me to wave the controversy in this publication, that I might avoid (as they say) giving offence to weak minds. But conceiving, as I do, that such a prejudice is injurious to the interests of agriculture, as well as disgraceful to the enlightened period in which we live, I do not choose to temporise. I pity those who labour under prejudices, but I consider it as the greatest favour I can confer on them, to correct their errors and misconceptions. I shall therefore proceed to state a few obvious facts, which, I trust, will not fail, if duly considered, to satisfy every impartial mind, that moss earth is not an antediluvian substance.

The waters of the deluge would certainly destroy the crops of grasses and other vegetables on the surface of the earth at the time of that event. But it is not likely that the waters would cut the grasses, &c. and lay them into heaps. If they had been so cut and collected into heaps, they must have rotted whenever the waters subsided. The Flood was sent to destroy, not to preserve. And if the waters had the quality of arresting,

forever, the progress of putrefaction, and decomposition of trees, grasses and plants, all of them would have remained; but even the Ark in which Noah was saved has long ago crumbled to earth. Had the mosses been intended to be set up, like Lot's wife, as monuments of the divine displeasure at the old, and beacons to the new world, and furnished with powers to resist the ordinary laws of nature, some notice would have been taken of them in holy writ. But they are nowhere mentioned in the sacred volume. The story of their antediluvian origin, is one of the deceptions practised in the dark ages, upon the credulity of the multitude, which their teachers have not yet thought proper to refute.

Had mosses been formed by the deluge, the trees found in them would have either been broken by the middle, or, more likely, torn up by the roots, and the roots would have been still found adhering to the tree. But wood is seldom or never found under moss, in either of these states. I have carefully examined fossil wood in all the counties of Scotland, and in several of those in England, and I have seldom ever found a tree with its roots adhering to the trunk, unless it was the small birch trees, and other aquatic shrubs, which have grown in the moss, after it had risen over the original wood to the height of several feet. I have seen many thousands of trees that had evidently been cut with an axe, or some such tool; and the roots or fangs still fast in the earth in which they grew. As many such roots may be seen in the greatest part of the mosses in Scotland, it is not necessary to enumerate instances. This single fact affords the most incontrovertible evidence, that the trees found under mosses were not overthrown, or these mosses collected, by the flood.

The mark of the axe is seen on many trees dug from under moss. Some have been found split, and the wedge remaining in the tree; others have been found with holes bored through them, and some partly burnt. A piece of wood, with a wimble bore into it, was, some years ago, dug up from under the flat moss, in the parish of Glassford, 10 feet deep. And I have in my custody, a piece of wood about 4 inches square,

with a wimble bore through it, which receives my thumb, found under a moss, on the lands of Mr. Brown of Newton, 12 feet below the surface. The Rev. Mr. Tait, in the Statistical Account of Kincardine parish, says, that the trees found under that moss bear the most evident marks of the hatchet, which seems to have been about two and a half inches broad, and that none of the trees are torn up by the roots.

Mr. Ure mentions a tree found in a moss near Renfrew, with a hatchet of an uncommon form sticking in its trunk.

In the Phil. Trans. No. 275, similar instances are mentioned of trees found in Hatfield moss, some squared, some bored through, some riven with wedges of wood and iron, and others having broken axes, of Roman figure, remaining in them. The Rev. Mr. Rennie mentions many similar substances in the 33d and 34th pages of his Treatise. Several trees have been dug from under Strathaven moss, with the marks of fire visible upon them. But these things are so common in all parts of the country, that it is needless to enumerate instances. It must far exceed even the bounds of credulity, to suppose that any of these operations could be performed by the deluge, or even by Noah and his family. Had only a few such trees been found, they might have been conjectured to have been such as had been misfitted in building the Ark. But it cannot be supposed, that Noah, and the few who believed in his prophecy, would cut down the greatest part of the woods in Scotland, to build his vessel, long as it lay upon the stocks, and large as it must have been.

Had moss-earth been collected by the flood, we should have found in it not merely wood, grass, and fog, * but also part of every other kind of plant and vegetable, which then grew in this island. We should also have found some of the dead bodies of the antediluvians, for whose destruction that awful deluge was sent. It has often been said, that the antediluvian world was more populous, and much more fertile, than the postdilu-

* By fog here is not meant that haze which we see in the atmosphere, when it is loaded with moisture, but a species of moss plants, well known in Scotland by that name.

vian. What then is become of the whole other productions of the animal and vegetable kingdoms; for we find nothing in moss but wood, and what some have imagined to be grass and fog. Towns, cities, houses, and utensils, must have abounded in the old world; and had the mosses been collected by the flood, these would have been found under it. Had this been the case, we might have been able to have ascertained the exact stature of the giants mentioned in holy writ, as well as the dresses then in fashion. Instead of searching for Roman vessels and antiquities, in the ruins of Herculaneum, we should have been able to have dug up from under our mosses, every species of dress, and every kind of utensil, in use in the days of Noah. The cabinets of the curious would have been enriched with vast stores of coins, armour, coats, bonnets, wigs, and snuff-mills, of the antediluvians. As moss preserves human bodies, and articles of dress entire, to any length of time, we should not now have gazed with astonishment at an Egyptian mummy only 2000 years old; for we might have found every where human bodies in full preservation, with their dress every way complete, a pattern to modern tailors, milliners, and wig-makers. The holy mother-church, too, ever disposed to revere what is ancient, might have found deposited in our mosses, vast treasures of caps, cowls, mitres, and holy relics of double the antiquity of any now in existence.

If it should be alleged, that this island was not inhabited prior to the flood, I would ask, who was it then that cut down all the trees whose roots we find every where so entire in the ground? Had Britain been then uninhabited, still we should have found reptiles, fowls, and such animals as then abounded: and the dead bodies of men and women would have been found under the mosses, on the continent of Europe and Asia.

Had the trees now found under moss been deposited there, and covered so deep by the deluge, they could not have suffered so much from corruption; as we find they have done. Trees floated on the waters for 40 or 50 days, and instantly buried deep under moss, might have been split and broken in some places; but they could not have been in the least injured by

rotting. Whatever effects their being so long soaked in damp earth might have had in loosening the longitudinal fibres of the timber, is needless to inquire. But sure I am, that had the trees been deposited by the deluge, where we now find them, they would not have been in the least impaired by corruption. They would still have retained the bark, and the under and upper sides of the tree would have been equally entire. This is not the state in which we find them. The large trees are always much impaired by corruption on the upper side. I have often found a large oak, with the bark adhering to the under side, while corruption had dissolved the same tree to near the centre above. The deluge could have no such effects; but the trees being exposed to the atmosphere, uncovered, for many years, till the moss rose over them, would have rotted to the middle, before they were completely enveloped in the moss.

Had moss been collected by the flood, the trees would more likely have been found above, than below the moss. Green herbage, or even that which had been dried, would, after being several weeks soaked in water, more readily sink to the bottom, than trees or logs of wood. After being floated several cubits above the hills, the trees could not have again returned, and each taken their stations in regular order where they grew, and near their own roots, as we now find them. Driven by the currents of the receding waters, they would more probably have been carried into the sea. Such as rested on dry land, would more likely have been laid in heaps, than in the order in which they lie. Oaks and firs would have been mixed, and laid on soil where neither of them grew. But we always find oaks on a clay soil, and firs on sand, where their roots are also found in the natural position.

Dr. Walker, in page 15th, observes, that mountain trees are found in the moss on mountains, and trees that grow in the vallies are found under mosses in low situations.

Mr. Rennie very properly puts the questions, (p. 60.) "If
" all the trees on moss have been water-borne, how comes it
" that, in almost every moss, the trunk is found lying by the

“root? Did these trunks, after performing their voyage, like dutiful children, return to be buried in the same graves with their parents? And how did each species, by some elective attraction, or magical charm, after being huddled together, return each to its own proper soil, the oak to the clay, and the fir to the sand, from which they sprang?”

Mosses are never to be met with in the warm climates. Will it be pretended, that the flood did not reach these regions?

The names of places, to be afterwards noticed, refutes the notion of moss being collected by the flood. I can point out upwards of thirty large farms, in the neighbouring parishes of Strathaven and Muirkirk, all of them mostly covered with moss, but still named by *wood*. That they were covered with growing wood when the names they now bear were first conferred, cannot be doubted; and who will pretend that these names were antediluvian? It is not possible that Noah and his family, had Avondale or Muirkirk been their native place, and the ark rested on Dungavel or Cairntable, instead of Ararat, could have known, and transmitted to the present day, the antediluvian names of all the neighbouring farms. Neither was the language of Noah the same with that now in use.

Had the mosses been formed of heaps of antediluvian herbage, it would have been all laid horizontally. But we find all the reeds and fibres of our mosses standing vertical; a clear proof that they have grown where they are.

The absurdity of the notion of moss being collected by the deluge, is further established by the great number of arms, coins, and utensils, found under it, and clearly known and ascertained to pertain to nations as of yesterday, in comparison of the antediluvians.

There was found a few years ago, under the moss of Locher, near Dumfries, a Phœnician canoe, and a Roman jug which contains about four gills. The Minister of Tinwald, in the statistical account of his parish (Vol. I. page 160.) terms this a Roman *modius*, but it seems to me to have been rather the Roman measure called *sextarius*.

but these have failed. A hole has been cut in the middle of the heel, probably to receive a tier to go round the ankle. In all of them the leather seems to have been as well tanned and curried as that now in use. The tannin with which the moss abounds, may have helped to complete their tan, but that in my possession has a fine lustre, and what is surprising, it is lined with sheep or goat's skin, or that of such like animal, and the two skins are so well pasted together, that it is impossible to detach them without tearing the leather to pieces.

A chest of Roman arms was found under a moss, near the house of Lord Macdonald in Sky.

A labourer found, when cutting peats, ten feet below the surface, on the estate of Logie Almond, Perthshire, the head of a spear of Roman bronze. A friend of mine bought it from him for two gills of whisky, but the factor refused to allow its being removed from the estate, and I trust he will keep it out of the hands of Tubal's race.

A brass vessel was found, some years ago, under a moss near Manchester, which has been preserved in the Muncunian library. It is about five inches and a half in diameter, and two inches and a half deep, with a flat handle. As the brass resembles that used by the Celtic Britons, it probably belonged to that people, or to the Romanized Britons.

A Roman medal of fine gold, and bearing a Roman inscription, was found under moss near the sources of the Annan, and on the side of the great road formed by the Romans, from Carlisle to the vicinity of Glasgow, generally termed Watling-Street.

I have seen in the Museum of Mr. Peter Crossthwaite, in Keswick, a metal ring; a coin of the Britons found under a moss near Carlisle; a handsome pick head of Roman brass, found under a moss about a mile west of Keswick; a Celt found in the Solway moss, and a Roman Censer found under a moss in Cumberland, with a great number of the bones of the Bison, and horns and core of the deer, &c. all found under mosses in various parts of Britain and Ireland.

In summer 1806, a piece of fine gold, of curious workman-

ship, resembling the bit of a bridle, and supposed to have been the ornament worn round the neck of the Arch-Druid, with upwards of thirty pieces of the same precious metal, about the breadth of a Roman Denarius, but much thicker than that coin, and bearing an impression resembling a star, were found by a country lad, under a moss in the summit of a hill, and near to a Druid's Altar, about a mile south of Dolphinton, near the marches of the shires of Lanark and Peebles. James Brown, Esq. of Edmonston retains that valuable relic of antiquity and several of the smaller pieces.

Some skulls of the Urus, and a Roman spear used in killing that animal, were found several years ago, in a moss near Selkirk, and are preserved by the Antiquarian Society.

Two pairs of vessels of Roman bronze, and of the manufacture of that ingenious people, were found under a moss, on the farm of Genderhill, already mentioned, in June, 1803. In figure and size they resemble a small brass ladle, one of each pair goes neatly within the other, and the inner one of both pairs is perforated like a drainer. The holes are remarkably well cut, and of a size to receive a pin, resembling a sheet of parchment formed into a meal sieve. This farm seems to have abounded with Roman Antiquities. For besides these vessels, and the sandal that has been mentioned, the head of an axe of a handsome shape, was found there a few years ago, but it has been brought under the hammer, and converted into another shape. A horse's shoe of a curious construction, was also found under moss in that farm.

None of the relics of antiquity I have mentioned, or many others which I could point out, can possibly be antediluvian. They are all known to have belonged to people as of yesterday, in comparison with those who lived before the deluge.

In whatever point of view the argument is placed, the notion of the mosses having been collected by the universal deluge, is too ridiculous for so full a refutation, were it not that the great body of the lower orders labour under that foolish prejudice, which stands as a bar to the cultivation of that description of soil. Some have argued with me, that the mosses

were so many standing monuments of the divine displeasure, at a rebellious world, and that to remove or deface them, was the same as to break down the statutes set up to warn the impenitent.

SECT. II.

1. *Moss is neither a Submarine production,*

2. *Nor composed of rotten wood, or an Earth of any kind.*

THE inhabitants of Holland having found moss-earth in the bottom of some parts of the sea on their coasts, have long had a vulgar tradition among them, that all moss-earth was a *submarine production*. Schotanus conjectures that the mosses which cover so much of Friezland, were originally formed in Norway, and brought over seas to Friezland. Like mosses in other parts of the world, they cover many trees that have grown in the subsoil; and this ingenious writer imagines, that these forests have been overthrown by an inundation, or some natural cause, and that the sea has transported from Norway all the moss-earth that now covers these forests!

The people who inhabit the banks of the Forth, where moss-earth very much abounds, having had much intercourse with the Dutch, have become proselytes to their notions as to the origin of moss. They have a tradition among them, that the mosses on the sides of the River Forth, were transported from the Continent, and laid down by the ocean where they now rest. One of the largest of these is termed *Moss Flanders*, from a belief that it came from Flanders!!!

These opinions are as absurd and unfounded as that of the antediluvian origin; but as they are not so generally and obstinately adhered to, or used as arguments against improvement, a refutation does not seem so necessary. They are all vulgar prejudices, of which any man of an ordinary degree of information and reflection would be ashamed; and they only deserve notice in so far as they are injurious to the improvements, which it is the object of this Treatise to recommend. Intelli-

gent people will scarcely take the trouble to read these strange opinions, and the answers I have made to them. But I trust all who have ever given ear to these opinions, will read my remarks with attention and impartiality.

It would be to no purpose to enumerate all the fanciful conjectures that have been formed as to the origin of moss-earth. They are numerous and incoherent; and as Dr. Rennie justly observes, they serve to shew, that that very important branch of natural history has not been duly attended to, nor as yet properly understood.

But it is not the illiterate and credulous only, who have formed extravagant notions concerning the origin of moss-earth. Men of Letters, who were much conversant in science, have entertained opinions on that subject, which are whimsical and unfounded.

“Picard, Lemnius, Piganoil and Grampaye are of opinion that moss-earth is a congeries of bark, boughs, leaves, and trees, or of whole forests overset and immersed in water, mixed with grass and reeds.”

“Lentilius and Commelinus think that moss is a marshy bituminous earth, mixed with ligneous and aquatic plants putrified under water. Stevenus thinks that it is a fat sulphuro-bituminous earth of rotten wood. Others have supposed that all mosses were originally lakes; and that when these were drained or filled up, they were converted into moss.” (Dr. Rennie’s introduction.)

Scheuchzar having extracted, by distillation, a bituminous oil from moss earth, concluded that all moss was a mere fossil bituminous earth, and that the admixtures of vegetable matter found in it were only accidental. Stahl entertained a similar opinion. Guicciardin, Oudhoff, and others, have conjectured, that moss was an original and primitive earth, formed at the creation of the world. But as neither the primitive or secondary strata of the earth contain the smallest traces of that substance, as it is only met with in certain climates, and as coins and utensils, bearing the marks of human art, have been found under moss, these conjectures can have no good foundation.

Morhoffius considers it as a minor earth, and classes it with coal. Some who entertain more correct notions as to the origin of the mosses now on the surface of the earth, have formed conjectures no less extravagant than those that have been mentioned. Having found that coal, when analysed, seems to be vegetable matter, or something resembling a vegetable substance, and that like moss, it is found in horizontal strata, they have recourse to conjecture and fancy to complete their theory of the formation of coal. They would have us believe, that all the different seams or strata of coal, found under the surface, have at some period been so many beds or strata of moss, formed above ground, and by some convulsion of nature buried deep in the earth, and there converted into coal.

As this theory does not so much relate to the formation of moss, as that of coal, and as I do not perceive that it stands in the way of the improvements I wish to see executed, the necessity of entering deeply into that controversy does not appear. It belongs to the inventors of that theory, and those who have become their proselytes, to shew that it is founded on solid data, and no way inconsistent with the general laws of nature. When they do so, I shall admit their theory, though at present it seems to me extremely fanciful. The formation of moss-earth on the surface, is limited to the temperate and torrid zones, while coal is found in every climate. In all the countries where moss abounds, it is not restricted to any particular species of subsoil, or over any particular mineral strata, but extends to all parts of the surface, where water has been detained. In Scotland, for instance, moss-earth abounds as much in the counties on the North and South of the kingdom, where no coal is found, as it does in the counties of Air, Renfrew, Lanark, Lothian, &c. where the coal seams abound. But if the theory of coal be such as these fanciful conjecturers would have us to believe, moss-earth has not been formed in these northern and southern counties to be converted into coal, as in the middle counties. What can have caused moss to accumulate *now* in those counties, where, according to the theory, it has not existed in former times?—Or, if moss did at all times grow

on these parts, how was it not formed into coal there, as well as in the middle shires?

In some parts, many different seams of coal are found below each other, to an unknown depth. If these have been so many mosses, formed on the surface, and afterwards buried one after another, the earth, or at least the coal districts of it, must have existed for a much greater period of time than Moses has affixed to it, and must have undergone many terrible revolutions, that have not been made known to him. I should wish to know from these theorists, whether the coal districts were originally as low as the under stratum of coal, at the time that stratum was formed in the shape of moss, or if the coal districts sunk from time to time, as the different strata of moss, now coal, were formed. I should also wish to know whether the intervening strata of stone, blaze, clay, sand, &c. between the different seams, were carried from some other part of the globe, and laid over the moss to the depth found between the seams of coal, or if these spaces were filled up by new created matter.

SECT. III.

Moss is not a Growing Plant sui generis.

BUT a theory no less extravagant, and from the manner in which it has been introduced, still more injurious to the interests of agriculture, has been invented by Doctor Anderson, some time of Aberdeenshire, author of a work entitled "The Bee," and several other publications on agricultural and philosophical subjects. That very respectable gentleman, who was possessed of distinguished abilities, much erudition, and scientific knowledge, published in 1799, a Treatise on Peat Earth, the chief design of which seems to have been, to induce a belief, that moss-earth is not a collection of vegetable matter which had grown on the surface of the earth, and was under a partial decay, but that it was itself a growing plant *sui generis*.

In support of this novel theory, or hypothesis, as he wishes to term it, the learned Doctor displays much ingenuity, and an extensive knowledge of nature; but an over anxiety to introduce and establish his favourite theory betrays him into some inconsistencies. Sometimes he is modest, at other times assuming, now he is grave, then he appears to jest, here he is diffident, there he is dogmatic. But in all his changes of tone, he uniformly aims at the overthrow of the opinions of philosophers, and the establishment of his new theory. I am doubtful how far Dr. Anderson ever himself believed the doctrine he teaches on that subject; as the whole seems to me, intended to try the extent of public credulity, and how far his splendid talents can be carried to induce belief.

He says he had imbibed notions respecting the nature of peat, and its original formation, which he conceived to be equally certain, with the most undoubted axioms in physics; that even when he had observed phenomena which he considered irreconcilable to his preconceived notions, he did not venture so much as in idea, to doubt opinions, which he conceived the experience of ages had confirmed. (Preface p. xi.)

A thought occurred to him, with respect to the formation of moss, which he suggested as an hypothesis, and offered as a matter of curiosity for *the speculation of Philosophers*. (Preface, p. xviii.) But the same degree of modesty is not to be met with through all parts of the Treatise; for (in Pref. p. xiii.) he says, that in the course of general conversation, and correspondence, he has scarcely found a single person, who has formed more distinct notions of the real nature of peat-earth, or of the circumstances that are necessary to be adverted to in improving it, than he himself had done.

At times he argues with much gravity, and strains every nerve to establish his favourite plant, and to remove every thing that stands in its way. Yet, (p. xxi. of the Preface) he says, that he considered it in a great measure as a *jeu d'esprit*, and if it were worth his while to be serious on the subject, he would say, &c. The matter seems too trifling for him to

argue about, "but he has no objection to throw out a hint for the recreation of such wranglers."

His hypothesis, which was thrown out as a matter of curiosity for speculation, he says was left to stand as a mere parenthesis, that might be either struck out or kept in, as the reader might incline. (Preface p. xviii.) But in other parts of the work he assumes a tone much more positive. For in pages 63d and 64th, he says, "Nothing can be so absurd, nothing so contradictory to reason and to every known fact, respecting the decomposition of vegetables, as the whole of the doctrine that has been so long implicitly adopted, respecting the formation of moss by means of decayed *Sphagnum*, or any other decayed plant whatever." And in page 68th he asserts in the same dogmatic style, that "It is therefore impossible for any human being, who spends but a thought on the subject, not to be satisfied, that to whatever cause we are to ascribe the origin of moss, it cannot be to that of the accumulation of vegetables which have grown on the surface, now in a state of decay."

Having shewn *negatively* that moss is not formed by *deposition, crystalization, congelation, exudation, or accumulation* of decayed animal or vegetable matter, he next proceeds *positively* to shew, that moss-earth is a growing vegetable *sui generis* (p. 68.) "It may be produced by the gradual increment of a vegetable matter still alive, and in a growing state, and *nothing else*."

In page 79th, he says "Moss is in effect a vegetable matter *sui generis*, which is produced in proper circumstances, though we are yet ignorant what these circumstances are*; and which

* The mode of reasoning in this paragraph is very different from that used in page 63d, though the doctrine in that passage is far from being so clear as that laid down in this. There the doctor declaims against a well established fact, terms it an insult to reason, and contrary to every known law in nature, merely because he is, or pretends to be, ignorant of the causes from which it proceeds. But when he wishes to introduce his heterogeneous plant, the mere creature of his own fancy, he is not afraid to record the fact, for which he cannot account; and moss must be a vegetable *sui generis*, though he is unable to point out the causes from which it proceeds.

"continues to increase to an immense magnitude, and to live
"to an indefinite age"

To make room for this strange plant, the Doctor seems to think it necessary to cut up by the roots all the generally received opinions of Philosophers, as to the origin of moss-earth. In his preface, page xv. he says, "The opinions that have
"been generally entertained by Philosophers, respecting the
"origin of moss, naturally come under review, and are shewn
"to be totally irreconcilable to well established facts."

At the time the Doctor was so busily employed in knocking down the opinions of others as to the origin of moss, he wishes to have it believed, that he had not so much as formed a notion of what he was to set up in their room. The want of a substitute does not in the least embarrass him. The opinions of Philosophers must be brought down at any rate, whatever may be reared in their stead. Accordingly, he pulls down the whole of the fabric; removes every part of it, and clears the ground, before he even forms a conjecture what he is to set up. When the first part of his "Essay was concluded, the Author
"had not been able to form even a probable conjecture as to
"the real origin of that singular substance."

It would seem that Dr. Anderson had not seen, or known, that a theory every way similar to that which he adopts, had been pointed out by some ingenious Dutchman, about a century before he wrote. (vide Dr. Rennie's Essays, page 61st.) It was strange that a man of such extensive information should not have heard of that theory of the learned Dutchman, and that when the Doctor did begin to look out for a theory, he should happen to light on that which some grave phlegmatic Dutchman had brought forward a hundred years before!

Be that as it may, nothing can be found to coincide more exactly than the first and second parts of the Doctor's Essay. The second contains nothing but what may be found in the first, every line of which is evidently calculated, not only to prepare the reader for the theory laid down in the second, but even that theory itself is as clearly stated in the first as in the second part. In demolishing the old building, he neither de-

faces nor scatters the materials, but cuts up every part of it, as much in the shape of the new erection, as if the plan of it had been laid before the former fabric was demolished. The sound of the workman's hammer did not need to be heard on these materials, when fitting up the new building. They were all ready, cut-and-dry, in the very shape and form that suited the new erection, and they were all at hand.

In combating the opinions of Philosophers, Dr. Anderson displays much keenness, and no small degree of address. Whenever he can bring any of the general laws of nature to bear upon these opinions, he does not fail to make a vigorous assault. But whenever any of these laws seem to run counter to his favourite theory, he softens his tone, and is not afraid to record a fact, though he may be at a loss to account for it.

No fact in natural history can be more clearly established, or is better known, than that in proportion as the putridity of the moss in the original mass advances, the inflammability of the moss-earth is increased. Every person that ever saw a moss cut into peat, knows, that the lowest stratum is much softer and much more decayed than the upper stratum of the same moss, in all cases, at least where the whole bed of moss-earth had been formed from the same species of moss plants, and kept in nearly the same state of humidity, as will be shewn in its proper place.

As putridity is always making some progress, though scarcely perceptible, the under stratum must be more dissolved than those above, and as that dissolution advances on the unbroken moss, inflammability is increased. Hence the upper parts of the moss bed are laid aside when peats are cut.

The late Dr. Walker, in a valuable Essay given in to the Highland Society, and published by that respectable Institution, justly observes, (page 40.) "That the blackest and most solid peat lies lowest in the stratum; it is the peat of the most remote era, and is always the most bituminated and inflammable. But the brown spongy flow peat, lying near the surface, and recently formed, though it catches fire readily, is not capable of such lasting inflammation, nor does it throw

“ out in burning, the same bituminous smell. It would appear
 “ that the inflammable vegetable matter, combined with the
 “ vegetable and other acids, alters by a very slow process, and
 “ ripens more and more in course of time into bitumen. Be-
 “ coming more bituminated by age, it becomes more inflam-
 “ mable, acquires a stronger repulsion to water, becomes
 “ more antiseptic, and more powerfully resists the further pro-
 “ gress of putrefaction.”

This well known fact Dr. Anderson seems to think stands in the way of his favourite hypothesis, and though it is a fact obvious to every man who ever paid the least attention to that substance, and familiar to every peasant who ever cut or used peats, yet the Doctor does not scruple to controvert it in the most dogmatic manner: After stating the facts, he adds, “ That
 “ is to say, in other words, as it becomes putrid it becomes
 “ more inflammable, which is directly the reverse of the well
 “ known progress of nature in other cases. Were such argu-
 “ ments to be admitted in physics, there might be an end of all
 “ reasoning entirely, for it is an insult on reason to say you are
 “ to reason by analogy, while you go directly contrary to every
 “ known law in nature that ought to constitute that analogy.”

It is really surprising that a Gentleman of such extensive erudition, and who has paid so much attention to natural history, and to every branch of rural economy, should thus attempt to banter mankind out of their senses, in a matter which every labourer, as well as every Philosopher, can attest that he is in an error.

His dexterity in establishing his favourite theory is amusing, and serves to shew his abilities, as well as his anxiety to promote the growth of a fanciful plant. Every term that can be construed, or even perverted into his service, is brought forward with great address. *Quick moss* is a term very common among the lower orders of people in every part of Scotland. It is merely a corruption of the word *quag moss*, soft or boggy moss, and it is so used and understood among all ranks in Scotland. Hence we talk of *quick moss*, *quick mire*, *quick sands*, &c. though every man who understands the language knows

that the terms are *quag mire*, *quag sands*, &c. The term *quag* or *quick* is applied to every place that does not support the foot of man or horse.

Dr. Anderson artfully seizes that term, which he could easily see was a corruption of another word, and impresses it into his service. He says, that the term *quick* moss, is meant moss that is possessed of vegetable life. And to render his theory complete, he *supplies* the counter term *dead* moss, which he does not even pretend to have been used by any other person. This, in the interpretation of Dr. Anderson, is made to imply moss-earth that is divested of vegetable life. The Doctor lays much stress on these terms. Quick moss is exactly that growing vegetable, that heterogeneous plant, which has sprung up in his imagination, or in that of some ancient Dutchman, and which they think covers so much of the surface of the northern parts of Europe; that very plant "which is produced in proper circumstances, and which continues to increase to an immense magnitude, and to live to an indefinite age." And because the corrupted term *quick* has been applied to moss, he conceives himself at liberty, not only to take it in a sense different from that in which it is used by the country people, but also to supply the counter term *dead*, and apply it to moss, which none but himself ever did. The *quick* moss is, with him, the great body of moss, which he pretends is growing; the *dead* moss is that on the surface, which he says is void of vegetable life.

The Doctor says, that there are no fissures in the quick moss, neither are any animals found in it. It is not true, that rents and fissures are not found in moss, below the surface. Every labourer who has cut peat from the deep mosses, can attest that it abounds with rents and fissures; and as the Doctor draws his line of distinction between the quick and the *dead* mosses, at eighteen inches from the surface, he cannot expect to meet with animalculæ farther down. He will find as few in solid clay at the same depth.

In page 44, he says, "Quick moss, wherever it is found, is an uniform solid mass." These are qualities in moss which

few have been able to discover. And it will be difficult to find any other plant that ever grew, with so little claims to the qualities of solidity and uniformity. The solidity of all deep mosses is so small, that they will not even bear the foot of man; they are in fact semi-liquid: and as to their uniformity, it resembles the uniformity of a Dunghill. If a Section of moss is cut up, the greatest diversity of materials, of colour, texture, and appearance, is discovered. In some parts putrefaction has made such progress, as to leave little or no vestige of the vegetable fibre, while in other parts, the vegetable organization is still visible. Solidity and uniformity can, with equal propriety, be applied to moss, or to a compost dunghill, and both have an equal claim to be ranked in the vegetable kingdom of nature. In neither of them can be traced the seed, the root, the stem, or any one of the distinguishing and essential characteristics of a plant. "It is" therefore, "an insult upon reason to say, you argue from analogy, when you go directly contrary to every known law in nature, that ought to constitute that analogy."

The absurdity of the Doctor's hypothesis will be further evidenced, when the true and proper origin of moss is considered, and the nature of that substance examined.

Without following the Doctor further at present, through all his ingenious turnings and windings, in planting, rearing, and defending this heterogeneous plant; without inquiring if it has sprung up spontaneously in his own fertile imagination, or if the seeds of it were sown in the head of some ingenious Dutchman, and, remaining dormant for a century, have only come above ground in the present day; or, without attempting to trace the singular plant through all its ramifications, and leaving some of his absurdities to be noticed in the sequel, I shall now proceed to shew in

CHAP. II.

POSITIVELY WHAT MOSS-EARTH REALLY IS.

MOSS-EARTH is nothing else than immense collections of the successive crops of aquatic vegetables, which have grown from year to year on the surface, in humid situations, and in a low temperature. These plants, from their innate qualities, have resisted, or at least, but slowly and partially yielded to putrefaction, and thereby remaining in a great measure stationary, after they had ceased to grow, have accumulated, in the form of moss-earth, to the various depths in which that substance is now found. All mosses which are covered with sward, are still accumulating, more or less according to the degree of moisture under which they remain, and the temperature of the atmosphere where they are situated.

This is what I conceive to be the true theory of the formation of moss-earth; but that it may be the better understood, and the origin of that substance made plain and easy to the meanest capacity, some farther remarks seem to be necessary.

SECT. I.

Moss-earth is produced by excess of Moisture, in a low temperature of climate.

THE most superficial observer of the beautiful economy of nature, cannot fail to have perceived, with wonder and delight, the immense variety, and wonderful gradations which pervade the works of Omnipotence. That astonishing variety appears no where more conspicuous, than in the vegetable kingdom. The diversity of vegetables, suited to every soil and climate, over the whole of the terraqueous globe, amounts to a sort of infinity. Those of the mineral and animal kingdoms are equally numerous; yet all the parts are admirably connected.

There are no leaps or chasms in the works of nature, but the whole, by gentle and easy steps, rise gradually, and almost imperceptibly, above each other, from a mite to a mammoth; from the liverwort or conferva, to the sturdy oak and the stately cedar, they make up one universal whole.

The vegetable, like the animal kingdom, is not only infinite in variety, but is also adapted to every description of soil, climate, and variation of food and treatment. If the soil is dry and barren, nature has provided succulent plants, to grow upon and enrich it. If it is fertile, the climate temperate, and the ground sheltered, plants of much larger dimensions and richer qualities, will rise spontaneously. The sandy deserts produce their peculiar plants; the lakes and stanks of water furnish their lilies and pond-weeds; the hottest and coldest climates, the driest and dampest situations, the most fertile and most steril spots, are all covered with vegetables. The cleanest stones, and the best polished marble, or pieces of painted wood, are, when exposed to the atmosphere, covered in a few weeks with liverwort or some other plants; and if these are suffered to remain and accumulate for a period of time, they will form a soil, in which more bulky plants will take root.

Every species of vegetables, as well as animals, delights in a soil, climate, and food suited to the diversity of their several natures. If the soil and climate are favourable, and the food in which the plants delight, is supplied in abundance, they will attain to the size and degree of perfection which Omnipotence has allotted to their species. But, if the soil or climate are rendered worse, or their food more scantily supplied, the plants either become dwarfish, or altogether cease to grow; and others better suited to such a change of circumstances, will instantly start up.

The slightest alteration in the humidity alone of any soil, or piece of land, will soon produce the most astonishing change in the herbage. Proper mixture of soils, the application of manures, and other improvements, will soon effect the most surprising changes, both in the species and in the quality of the vegetable productions. Such alterations in the herbage,

are familiar to those who have seen a marsh drained, a barren spot manured, or a rich field neglected and laid under too much moisture.

A rich soil, lying in moderate temperature of climate, never fails to yield a luxuriant crop of rich and succulent herbage. But any description of soil, that is overburdened with water, and in a low temperature, will always be found to produce plants proportionally scanty, and of small value.

Dr. Anderson seems to consider it as an inscrutable mystery, that moss-earth is only found to cover some particular spots. But nothing can be more easily accounted for. A cold climate, and a soil overcharged with moisture, are every where the only causes of a decrease of the richer grasses, and of the introduction of that description of plants, which contribute to the formation of moss-earth. It is from the successive crops of these plants, accumulating on the soil, that all the moss-earth that now disfigures and encumbers so much of the surface, has been formed.

The rich grasses never fail to rise on the dry fertile ground, where the cold is not too great. And with equal certainty, we will find that a soil over-charged with moisture, and where the cold is chilling, always produces those plants which contribute to the formation of moss-earth. Wherever a spring oozes up, and spreads over a lower surface, unless the waters of the spring are impregnated with calcareous matter, the succulent herbage will disappear, and the moss plants will start up. The same thing will happen wherever too much water is detained on the ground, by whatever means that may be occasioned. These plants which grow on damp places, from their antiseptic quality, to be afterwards noticed, do not dissolve by putrefaction, but accumulate on the soil, in the course of years, to a bed of moss-earth. Hence the vast number of small patches of moss, which we find below the places where springs appear above ground.

The soil, which these, and all other descriptions of moss-earth cover, was as good and fertile as that of the neighbour-

ing lands, where no moss has accumulated, and where the plants that contribute to its formation have not been introduced. Were these parts of the soil only relieved from the incumbent moss-earth, and the spring or other moisture from which it originated, drained off, the soil would remain for ever clear of moss-earth, and the plants that form it.

Cold and moisture, to a certain extent, are both necessary to introduce and promote the growth of those tribes of plants which contribute to the formation of moss-earth. Hence we find, that it does not accumulate in the warmer regions, whatever may be the quantum of moisture on the soil: and in the temperate and frigid zones, moss-earth will never accumulate to great extent, unless a considerable quantity of moisture is detained, in a stagnant state, on the surface, sufficient to chill and banish the richer plants.

Moss and dry land are often found mixed in alternate patches, but if the state of these patches were changed as to moisture, the dry land would come to be buried under moss, and that now covered with it, would thereafter remain entirely free both of moss and the plants from which it is formed.

This is no fanciful theory, but a doctrine well established by facts visible to all. The subsoil of all the mosses I have ever seen, are as rich, and every way as capable of producing grain, and yielding the richest grasses, as the soil of those patches or fields that lie intermixed with these mosses.

Many of the deepest beds of our mosses rest upon a subsoil, which, at some former period, produced the richest of grass, trees and grain, and in which the moss plants had then no footing. Kincardine moss, to be afterwards described, affords one instance, among many that might be named, of a rich subsoil, where good grass and trees of the largest description, have grown, for hundreds or for thousands of years; till by felling the trees and leaving them on the ground, the water was detained on the surface, to such a degree as to extirpate the productions of the dry land, and introduce the aquatic plants, which contribute to the formation of the moss-earth; and when these noxious tribes once get a footing, they continue to grow,

and soon form a stratum of moss-earth, which every year's growth serves to deepen.

Wherever the moss can be shewn to have been of a recent formation, no doubt can remain, but that, until it began to be collected, the rich grasses and other productions of the dry land, had grown on the original soil. Until the moss plants are introduced, no such thing as moss-earth can be formed, and whenever these plants rise on the ground, the accumulation of moss-earth is certain. But evidences still more incontrovertible may be adduced.

Not only the marks of the Plough, regularly formed ridges, furrows, and wattling hedges, but even the plough itself, corn, corn-mills, &c. have been found under deep beds of moss-earth. Whitaker in vol. I. of the History of Manchester, page 349, says, that ridges, furrows, and traces of the plough, have been plainly discovered in the subsoil, under the mosses in Yorkshire, and in many of those in Ireland. He refers to Camden, C. 850, and to Mortimer's Husbandry, part II. page 27th. From the same authority it also appears, that in Ireland wattled hedges, and burnt stumps of trees, with cinders in them, have been found under moss, ten feet in thickness.—Dr. Rennie mentions many instances of improved land, mills, &c. being found under moss-earth.

From these, and other instances that might be adduced, it is evident, that the introduction of the moss-plants proceeds from the soil being overcharged with moisture; that land which has yielded the richest grasses, and been under improved culture for many years, may, by the stagnation of water on its surface, have all its rich herbage banished, and the tribes of moss plants introduced. And it is equally certain, wherever these aquatics are once introduced, they will, in course of time, accumulate to a bed of moss-earth over the original soil, of a depth proportioned to the degree of moisture, which is suffered to become stagnant on the surface.

SECT. II.

The Putrefaction and Decomposition of the plants that form moss-earth illustrated.

To render the process of nature, in the formation of moss-earth, plain and familiar to the meanest capacity, it is proper to notice, that plants are as much varied in their qualities, as in their species. To trace out and describe all the diversities of quality to be met with in the vegetable Kingdom, would be as remote from this subject, as it would be beyond my capacity to accomplish; one of these qualities, however, is so intimately connected with the subject under discussion, that it falls to be noticed.

Every plant, after it has attained the age, size, and degree of perfection suited to its nature, ceases to grow. Some plants attain to that perfection in a few months, some in a season, some in two or three seasons, and others live and grow for several centuries. But to whatever age they may attain, all of them cease to vegetate sooner or later, and from that moment they become subject to putrefaction; or, in other words, to a dissolution of these component parts. That terrible and irresistible destroyer, Putrefaction, begins its work as soon as the vegetable life terminates; and it steadily pursues its course of destruction, till every part of the vegetable fibre is reduced, and all the substances of which the plant had been composed, entirely separated. Vegetable economy collects from the earth, and the air, such substances as are best suited to the nature of the particular plant, and forms them into organic texture; every different plant according to its kind. But nature has appointed, that these substances are not to be lost, but must all be restored to the common stock. The process of dissolution follows that of organization, annihilates the plant, and either restores the substances of which it was composed, to the elements from which they had been taken, or at least sets them at liberty to enter into new compounds, according to the most powerful attractions.

The process of putrefaction, on all vegetable matter, is constant and certain, but is not in all cases equally rapid. On some vegetables the progress of putrefaction is speedy and uninterrupted, but on others it is greatly retarded, and extremely slow. Berries, for instance, that are completely ripe, wheat, or other grain abounding with gluten, and all plants which are cut down in the luxuriance of their growth and abound with vegetable jelly, will, if exposed to due proportions of heat, air, and moisture, be dissolved by putrefaction in a few weeks or months; while the ligneous fibre of oak timber, will resist the powers of that destroyer, for several centuries. The process is, in all cases, more or less rapid, according as moisture, air, heat, and other relative circumstances are propitious, but even where these are not duly supplied, putrefaction will always be found advancing more or less.

The wisdom and goodness of Omnipotence, are displayed in the appointment of such a power, and at the same time placing it under such restraints as to prevent it from destroying vegetable or animal life. If putrefaction did not annihilate animal and vegetable bodies, after they had ceased to live or grow, they would encumber the earth, so as to render it uninhabitable; and if the vegetable food were to continue shut up, and detained in these dead bodies, new crops of vegetables could neither find aliment, nor could animal life be supported.—The extent of vegetable or animal matter in the soil, under a partial decomposition, and on which putrefaction is constantly acting, and thereby preparing daily food for a new race, forms the sole distinction between a steril and a fertile soil.

But if that dissolution proceeded with too great rapidity, and was under no restraint, the rains would wash into the sea, the sun exhale into the atmosphere, or the wind carry off, all the food of the future crops of vegetables; the air and the sea would become putrid, and the soil would be bereft of vegetable aliment. But the process of putrefaction, or separation of parts, is so counter-poised by an indestructible or insoluble quality, placed by the Creator in all vegetable matter, that the separation or dissolution seldom proceeds so rapidly, as to in-

jure the health of man, or other animals, or to divest the soil of vegetable food. On the contrary, in some plants, and under certain circumstances, the process of dissolution is resisted, and too much retarded by the counteracting powers of insolubility.

This is the case in an eminent degree, with the plants that contribute to the formation of moss-earth, and with that substance which is composed of a congeries of these plants under a partial decay. The plants and grasses which rise on a fertile soil, in a moderate temperature, do not resist putrefaction, so as to accumulate into a vegetable earth. All their parts are separated in the space of a few months, from the time their vegetable life terminated; and the substances of which they are composed are converted into food for new plants. But the aquatic plants do not come under that rapid decomposition which dissolves the richer grasses. They are much more insoluble, and remain much longer stationary, or but little affected by putrefaction. Nature has furnished them with power to resist for a long time, the progress of that destroyer, and of retaining some part of their vegetable fibre and original texture un-reduced. And as new crops of these plants are always growing on the surface, over those of former years, which are only partially decomposed, they accumulate in the course of time, in the shape of moss-earth, to a great depth.

None of the plants, which contribute to the formation of moss-earth, are able, completely to resist the dissolving power. On the contrary, some of them of the richest kinds, soon lose all appearance of vegetable texture, and are reduced to a sort of black mucus. Others, however, hold out for many centuries, resisting all the force of the destroyer, and preserving the vegetable fibre but little impaired.

Their powers of resisting putrefaction, are in part regulated by the temperature of the climate, and quantum of moisture on the soil, and partly by the qualities of the plants themselves. If the moss be situated in a warm climate, and its surface kept moderately dry, the decomposition of the plants will proceed *more rapidly*, than where cold and moisture are more preva-

lent. And where the *Holcus Lanatus*, *Melica Cerulea*, *Anthoxanthum Odoratum*, any of the *Agrostes*, *Carices*, some of the *Junci*, &c. prevail, they are much more disposed to yield to putrefaction, than the *Bryum Hypnoides*, *Polytrichum Commune*, *Eriophora*, *Juncus Squarrosus*, *Scirpus Cespitosus*, and others. Some of the plants first mentioned are not properly moss plants, but the very best of those that grow on a dry soil; but they also grow on hill and bent moss, and are sometimes found in a dwarfish state even on flow moss.

There is frequently considerable difference in the solubility of some parts of the same plant; the leaves or foliage are always more disposed to yield to putrefaction than the stems and roots. The roots of the *Melica Cerulea*, for instance, extend deep into moss soil, are numerous, and very insoluble, but the foliage and stem are as soluble as any other grass. The leaves and stem of the *Eriophora* and *Scirpus Cespitosus* yield much sooner to putrefaction than the roots, which are very insoluble, and which are found many feet below the surface, like handfuls of milled flax, so tough, and the texture so entire, that it can be spun into a thread. I have specimens of the root of these plants, which I took from a moss in Lancashire, and from another on the estate of Throsk, on the Forth, at least ten feet below the surface, and so tough, that they are spun into a thread of the thickness of that used in making carpets. In some places of Scotland, it is denominated *Witch's* or *Old Wife's Tow*, and in other places it is termed *Ket*. The sharpest spade, or other instrument, will not cut it, and, as it rests upon, and covers the edge of the tools, it is a great hindrance to the workmen when cutting moss for peats, or any other purpose.

The heaths (*Erica Vulgaris*, and *Erica Tetralix*) are plants which present a powerful resistance to putrefaction. I have often found their texture visibly preserved in mosses of the greatest depth, and seemingly of the earliest formation. I have in my custody, some sprigs of heather, taken from a moss, twelve feet below the surface, so entire, that I can form them into a ring for the finger, and so elastic, that they immediately assume their natural shape when the pressure is withdrawn.

They are by no means sprigs, suddenly, or accidentally buried in the moss, for they abound in all parts of it, and are evidently the plants which have grown on the surface, and been buried so deep by the accumulation of the moss-earth over them.

SECT. III.

The ingredients in Moss Plants which promote or retard putrefaction, pointed out.

It might be advantageous to know, what are the ingredients in the plants of Cryptogamia, or the other orders that grow upon moss, and contribute to form it, which tend to retard or counteract putrefaction, as well as the compounds which are formed in the course of that slow and partial decomposition which they undergo. We must look up to the Chemist for such information; and it is to be regretted, that the chemical analysis of vegetables has not been inquired into with that degree of attention it so justly merits. The analysis of Algae and Lichens, which contribute so much to the formation of moss-earth, has been almost entirely overlooked.

Of the known ingredients of plants, some are antiseptic, and tend powerfully to resist putrefaction, while others serve to accelerate that process. The acids, tannins, the bitter principle, extracts, &c. may be ranked among the former, while the oils, gums, sugar, jellies, gluten, &c. fall under the description of the latter.

The extent of these ingredients in vegetables, is governed partly by the soil, climate, and food on which they are reared. *Acidity*, for instance, is never wanting in a greater or less degree in some species of plants, as in sorrel (*Rumex acetosa*) sloe (*Prunus spinosa*) plum (*Prunus domestica*) roan (*Sorbus aucuparia*) &c. Whatever may be the soil or situation in which these plants grow, they always abound in acidity. But the quantity of that ingredient is also materially affected by the soil, situation, and climate, on which the plant is reared. Apples or Plums, raised on a bleak hill, in the north of Scot-

land, must contain much more acidity, than those which are raised in the South of Europe ; and those that grow on a wall, are different in their proportion of acidity from those of the same species which grow in the very garden which that wall encloses.

That diversity in the quality or the ingredients of the plants is not restricted to fruits, but extends more or less to grasses, and other vegetables. Grass, that has sprung up at the side of a Dung-hill, will contain a much larger portion of mucilage, and of course, will be much more disposed to go into putrefaction, than an equal quantity of the same species that has grown on the steril top of a bleak hill.

Chemists have distinguished the acids found in vegetables into nine different kinds. One of these, the *Oxalic*, abounds in all the different species of the *Rumex*, in *Tormentilla*, in the *Iris Florentina*, *Iris Nostras*, *Berberries*, &c. plants that grow on, and contribute to the formation of moss-earth. The *Tartaric acid* predominates in sorrel (*Rumex Acetosela*) and in the roots of couch grass (*Triticum Repens*) which are among the first plants that grow on moss, when begun to be cultivated. This shews that that acid also abounds in the soil.

In the few experiments which have been made in moss-earth, the *Gallic* and *Suberic Acids* have been discovered in abundance. Of course the Moss plants must either contain these acids, or at least the base from which they are formed, as putridity advances. The powerful effects of lime and other calcareous manures upon Moss, prove the existence of an acid, which these manures neutralize.

But though the acids in moss plants have not been examined and classed, it cannot be doubted that all the plants which grow upon marshy and mossy soils, contain a much greater proportion of acid than can be found in the plants which grow on dry land. Every farmer speaks of the *sourness* (which is his term for acidity) of the plants which grow on moss and marshy ground. The *Carices* and *Equiseta* are the chief plants on these situations, and both are known to every farmer as *sour* grasses, and certainly a large portion of acidity is found in all the numerous species of both these tribes of plants. *Ernhoff*, who is

of the same opinion as to the quality of that description of soil, terms it *acid vegetable mould*. It contains, he says, a large portion of *Phosphoric* and *acetic acids*, which give it the property of reddening vegetable blues. It also contains an extractive, which is insoluble in water, but is rendered soluble with Alkali.

Every farmer knows, that when such ground is divested of redundant moisture, and manured with lime, it produces the most luxuriant crops of good grain. This is what all of them have witnessed, though they might be unable to assign the cause of such fertility. In their natural state, the *Acids* in the herbage, and in the soil, are injurious to the vegetation, and have the tendency to prevent the *extractive* from being reduced by the atmosphere. But when lime, marl, or any other *Alkaline* substance, is applied, they encounter the acids in the soil, and in the plants which cover it, and a neutral salt is thereby formed, which is the best food of plants. These acids being thus destroyed by the Alkali in the lime, the extract, which they had kept in a state of insolubility, is operated upon by the atmosphere, yields carbonic acid, and enters into other combinations, which are propitious to the growth of vegetables.

Tannin is another ingredient found in the plants that grow upon moss, and of course in the moss-earth itself. Heath (*Erica*) abounds in Tannin. *Tormentilla Officinalis*, which grows on all descriptions of moss ground, is one of the most powerful astringents that is to be found, and abounds in Tannin. Many of the mosses have been formed over vast numbers of oak trees, the bark of which contains a powerful Tan; and the mountain ash (*Sorbus Aucuparia*) which grows in moss, also abounds with Tannin. The connection between the soil and the herbage it produces, is so intimate, that the qualities of the one may be expected to be found in the other. And where the soil is formed of the herbage which grows on the surface, as in the case of moss-earth, the connection must be much greater than where the soil is not so formed. Though I have not been able to make the necessary experiments, to ascertain the fact, I have every reason to think that the *Bitter* principle,

and also *Extract*, abound in the plants which grow upon, and contribute to the formation of moss-earth. Hence it is that all these plants are so unpalatable to cattle.

Thus it appears, that the plants which moss produces and from which it is produced, contain a large portion of *Acid*, much *Tannin*, some of the *Bitter* principle, and *Extract*; ingredients, of all others, the most antiseptic, and which have the most powerful tendency to resist or retard putrefaction; while neither *Gluten*, *Oil*, *Gums*, *Saccharine* matter, *Jelly*, nor any of those ingredients that tend to accelerate putrefaction, can be traced in these plants. These retard putridity, render the plants unpalatable to cattle, and their want of *Oil*, *Gluten*, *Gum*, and *Saccharine* matter, renders them coarse, hard, and very far from being so nutritive, as if they possessed these enriching qualities.

Having shewn that moss-earth is a collection of vegetable matter, which has grown from year to year on the surface, and accumulated under a partial decay, over the original soil, in moist situations, and under a low temperature; that such plants are rendered insoluble from the abundance of *Acid*, *Tannin*, *Bitter* principle, *Extractive*, &c. and the want of *Gums*, *Oils*, *Gluten*, *Sugar*, and other richer ingredients which also render them unpalatable to cattle; and that such earth has accumulated, and is still accumulating, I now proceed to shew in

CHAP. III.

THE DIFFERENT SPECIES OF MOSS-EARTH FOUND IN BRITAIN,
THE PLANTS FROM WHICH EACH HAS BEEN FORMED, AND
THE CIRCUMSTANCES WHICH HAVE CONTRIBUTED TO THEIR
PECULIARITIES OF QUALITY.

THE great diversity in the qualities, and appearances of moss-earth, and the variety of plants from which that substance has been formed, have occasioned considerable differences in opinion as to its classification. I shall first notice the rules of classification proposed by others, and assign my reasons for rejecting them, and next point out what seems to me the best mode of arrangement.

SECT. I.

Arrangements proposed by others, considered.

SOME have attempted to distinguish moss-earth into different species, by the diversity of its colour, others, by its density; some by its specific gravity, others by the materials of which it is formed; while Dr. Anderson, discarding all other distinctions, ranks the whole under the classes of *quick* and *dead* moss.

None of these seem to me to furnish a proper rule of classification. There are, no doubt, considerable varieties in the colour of moss-earth. When newly cut, the colour nearly resembles that of Norwegian tar; but on being exposed for a short time to the atmosphere, part of it becomes black, the greatest part a dark brownish black, and some of it a sort of grey, or dark coloured drab, which becomes gradually whiter when exposed to the atmosphere.

The degree of density, as a rule of classification, is liable to the same objections. For, density or compactness in moss, and its being of a loose, open, and fibrous texture, proceed from

the same causes, and are found in the same moss-earth that appears to have a diversity of shade or colour; the most dense, solid, and compact moss being always of the darkest, and that which is of the most open and fibrous texture, always of the lightest colour.

Gravity proceeds also from the same causes as the shade of colour, or the degree of consolidation. The open, spongy, fibrous, grey coloured peat, is always the lightest, and that which is most dense, compact, and of the blackest colour, is always the most weighty.

But though these diversities of colour and qualities proceed from the same causes, yet none of them afford any proper rule of discrimination.

If these diversities of colour and quality were uniform in any moss, or in any part of the strata, they might serve as a standard of classification. But no such uniformity is any where to be met with in the moss stratum. Neither in Hill moss nor in beds of black earth; approaching to moss, which covers so much of the moor ground in Scotland, nor in the bent moss (both to be afterwards described) can any of the varieties to be afterwards mentioned, be traced. In the former, the moss stratum is too thin to contain such varieties, and the latter is always of one uniform texture, quality, and aspect, whatever may be the depth of the stratum. These diversities of colour and quality are only to be met with in the deep, or flow mosses.

Even in the deep mosses, no such thing as uniformity prevails. In every moss, some of the blackest peat is found next the subsoil, and that which is of the blackest colour, is always the most solid, compact, weighty, and forms the most durable fuel.

Where the surface of the moss field has been kept nearly in the same state of humidity, during the time of the formation of the strata, the lightest coloured peat, the softest, the least weighty, most fibrous, and least valuable as fuel, is always found on the surface. As you sink deeper into the stratum, it will gradually assume a darker tint, greater density, and

more weight. But as that uniformity of surface, and equality of state, are seldom to be met with over any great extent of surface, while the moss-earth is accumulating, it will seldom happen that the gradation proceeds regularly from the top to the bottom of the moss-earth.

When a Section of moss-earth is laid open, the diversity of colour, and other qualities which have been mentioned, will seldom be found to proceed in uniform order, or in regular strata, but in a sort of confused mixture. If a line is drawn on the face of the section, either horizontal, or perpendicular, it will be found to intersect, in a short course, different patches of moss, of a light and of a dark colour; moss that is compact, and that which is open and fibrous; moss which, when dried, forms weighty peat, and that which is nearly as light as tow; moss which makes a durable and powerful fuel, and that which forms a weak fuel of short duration. These diversities of aspect and qualities of the moss, do not terminate abruptly or change completely; but like the colours of the rainbow, they change so gradually and imperceptibly, that it is impossible to point out where the one begins, and the other terminates.

These varieties proceed from a diversity in the progress of putrefaction; that diversity proceeds from the qualities of the plants, and the quality of these again is governed by the degree of moisture on the surface, where those plants grow which form that particular patch of the moss stratum. Every part of the moss soil is overcharged with water, otherwise the succulent plants, and not the aquatics, would form the herbage. But as there is great diversity in the quantum of water suspended on the surface of the moss in the temperature, so there is also a corresponding difference in the nature and qualities of the moss plants, both in the species that grow, the qualities they possess, and that of the moss-earth into which they are ultimately formed.

In all hill and bent moss, and even in deep moss, the *Agrostes*, *Festuca*, *Holcus Lanatus*, *Carices*, &c. grow among the Heath, the *Hypna*, and others that are properly moss plants.

Wherever there is a mixture of these rich grasses, and the soil is not laid under stagnant water, putrefaction advances much faster, and the reduction of the vegetable fibre is much more complete, than where none of these rich grasses are found.

All the black weighty solid moss, which forms the most durable and best peat, is composed of the remains of these, and such like plants that are most disposed to yield to putrefaction; and all the light, fozy, loose, drab-coloured moss, is formed of the *Sphagnum Palustre*, *Bryum Hypnoides*, *Eriophora*, *Polytrichum Commune*, &c. but chiefly of the two first, which strongly resist the dissolving power.

If the moss plants grew entirely separated from each other, the change in the aspect and quality of the moss which they form, would be equally distinct. But though the *Sphagnum*, &c. are the prevailing plants in the gutters, and a considerable number of the richer plants grow where there is little moisture on the surface, yet they are so mixed on all moss soil, that it is impossible to draw any line of demarkation. The richest plants do not grow in the gutters, but some of them appear near them, and the *Sphagnum*, &c. rise more or less in every moss soil. Hence it becomes impossible to draw any line between the moss of one kind, and that of another. The lumps of both change gradually to the colour and qualities of the other, in the same way that a dry knoll or hillock sinks gradually into a stank or gutter, and a gutter rises into a height.

These diversities in the patches or lumps of different kinds of moss in a section, frequently appear above and below each other, as well as on either side. This must proceed from the rapidity of growth and slowness of decay of these plants which grow in the gutters, compared with those which grow on the dry parts of the moss. The *Sphagnum*, &c. which grow in the stanks, rise speedily in close cushions; and as putrefaction advances slowly on these plants, they soon raise the stank or gutter into a height, and the cushions of the *Bryum Hypnoides*, &c. rise like small cocks of hay still higher. The plants that grow on the driest parts of the moss, are not so bulky, do not grow in such clusters, and are more completely reduced by putrefac-

tion after their vegetable life terminates. The consequences are, that in course of time, the stank or gutter becomes the greatest height, the water takes a new course over what was formerly a dry place, and converts it into a stank, the richer moss plants are banished from that spot, the Sphagnum rises in their stead, and forms a patch or lump of white soft light moss, over a stratum of that which is blacker, more weighty, and more valuable. As often as a change is effected on the humidity of any part of the surface, so often will different herbage be introduced, and the mosses formed from such diversified herbage, will also be different from each other.

It must therefore be obvious, that neither the diversities of colour, weight, solidity *, nor of inflammability, afford proper criteria for the classification of moss earth, when its uses in agriculture are the subjects of inquiry.

I am also humbly of opinion, that the plants which grow on the surface of moss earth, afford no proper data for the classification of that substance. These plants are by far too numerous, to be capable of answering that end; and as every moss is formed, not from one or a few, but from many different plants, it would be difficult to fix on that which should confer the name. Twenty different species of plants, growing on a moss soil, may frequently be found on a space which might be covered by a Quaker's hat. It would therefore lead to a Babel-confusion, were the names taken from the herbage. One piece of moss might, in that case, have twenty different names assigned to it.

Dr. Walker divides moss, or peat, into seven different kinds,

* The diversity in colour, solidity, weight, and value of moss-earth is very great; I have two pieces in my custody, taken from peat stacks in my neighbourhood, a square inch of the one is ten times the weight of the same dimensions of the other. The one is nearly as solid and weighty as a piece of coal the other resembles a handful of half rotten tow. The former is jet black, and in it no traces of the vegetable fibre can be recognised; it burns like good coal. The latter is of a light drab, or rather a grey whitish colour, is open and foxy, and burns readily, but has no duration, and the remains of the vegetable fibre are visible to the naked eye.

viz. *Wood peat*, *Flaw peat*, *Heath peat*, *Gramineous peat*, *Inch peat*, *Consumed peat*, and *Water-borne peat*.

Some of these distinctions seem to have been taken from the plants, which in his opinion have contributed abundantly to the formation of the moss-earth, as *wood peat*, *heath peat*, *gramineous peat*. The term *flaw peat*, refers to the aspect or condition in which that description of moss is found. *Consumed peat*, is that which has been most completely reduced by putrefaction, and of course forms the best fuel, and is of the blackest colour. I have already assigned the reasons which induce me to reject these modes of classification.

Inch peat, is so named by Doctor Walker, on account of an admixture of some matter more inflammable than ordinary peat. But it does not appear to me, that such accidental admixture can warrant a moss being considered as a different species. Springs from below, streams of water above, the winds, or various accidents, may throw a mixture of other substances into the moss; and, if all such admixtures were to add a species to the tribe of moss-earth, we might soon have not only seven, but seventy times seven, different species. Dr. Anderson mentions a peat of a similar quality, found in Aberdeenshire, and terms it *Greasy clod*. Something of that kind has been found in different parts of Scotland and England. They seem to proceed from some impregnation of fossil petroleum, mineral oil, or other bituminous admixture from the subsoil. Many such peculiarities may be traced in moss-earth. The peat used as fuel by Mr. Cochrane of Carnduff, in the parish of Avendale, Lanarkshire, is so strongly impregnated with sulphuric acid, or some such substance, that if the smoke funnel is not carefully swept at least twice every week, it kindles and blazes with great rapidity. This seems to deserve the name of *fire-raising peat*. But if every such accidental admixture were to receive a new specific name, the nomenclature of moss-earth would become voluminous.

Water borne peat seems to me another unnecessary distinction. Moss has often been removed by different powers, but it is not necessary to invent a specific name for each.

The terms *quick* and *dead* moss, invented by Dr. Anderson, seem no less exceptionable. He denominates the moss of the greatest depth, which is altogether unconnected with vegetable or animal life, the *quick* moss, and that on the surface, on which plants grow, he calls *dead* moss. The intelligent Dr. Thomson, vol. v. page 427, of the last edition of his Chemistry, says:—"the life of vegetables consists in two things, 1st. remaining unaltered when circumstances are unfavourable to vegetation, and 2d. exhibiting the phenomena of vegetation when circumstances are favourable. When neither of these happens, we say the plant is dead." As I cannot discover any of these evidences in the lower stratum of moss-earth, I conclude, that it is as dead as a body of the same dimensions of clay or sand. But Dr. Anderson's notions on that subject are *suorum generum*.

SECT. II.

On the classification of Moss-Earth.

THE only arrangement that I can discover as either necessary or practicable, in the classification of the different kinds of moss-earth, is that which relates to its utility, the aspect it presents, and the invitation it holds forth to the cultivator. I can point out no other rule of discrimination that can be brought to any certain standard, or traced to any useful result. The utility of any moss in an agricultural point of view, is by far the most important inquiry concerning it, and of all other things it is the most perceptible.

All the mosses I have seen in Great Britain, in so far as regards either aspect or utility, may be easily classed under three kinds, viz:—*Hill Moss*, *Bent Moss*, and *Flow Moss*. I shall endeavour to explain these in their order; point out the plants from which each is formed, and the relative circumstances which seem to have raised that species of moss, on the particular soil and situation in which it is found.

SECT. III.

Of Hill Moss, and the Plants from which it is formed.

HILL Moss is that description of moor soil which is met with in every elevated situation, in cold and temperate climates, where the declivity of the ground, or the permeable nature of the subsoil, prevents that stagnation of moisture which is necessary to the formation of more complete moss-earth. Immense tracts on the sides of hills, and all high moorish ground not very retentive of moisture, and to which the plough has never reached, are covered with this species of moss-earth. It is an incrustation frequently of a few inches only, and seldom more than a foot in depth, in the form of a black moss-earth, or black mould approaching to moss-earth, which grows over the dry hill ground, on a sandy or gravelly subsoil, where water easily percolates, or the declivity is such as to facilitate its escape from the surface.

Over a soil of that description, or in that form undisturbed by the hand of the cultivator, a thin stratum of black mould, or semi-moss, is frequently formed, where heath, and the other plants after-mentioned are the chief herbage. This is what I denominate moor ground, or *Hill Moss*.

Dr. Anderson notices this description of soil, under the denomination of heath mould, but considers it as very different from moss; and no doubt it is different from the Moss described by him. It seems also to be different from bent-moss, and from flow-moss; it is moss in miniature; moss that has begun to be formed over another soil, but being starved of moisture, has not attained the state of moss in perfection.

This species of moss-earth covers immense tracts of land in all parts of Scotland, and even in some parts of England. The sides and skirts of hills and mountains, all moorish land of a poor thin soil, having a tolerable degree of declivity, and many extensive tracts of ground nearly level, where the original soil is dry and permeable, are covered with an incrustation of Hill-moss. The battles of Sheriff-muir, Falkirk, and Culloden,

were fought on fields covered with that kind of moss; but that at Falkirk has since been cultivated. This covers more of the surface of Scotland than all the other kinds of moss.

Hill-moss is generally of too thin a stratum to admit being used as fuel. Dr. Anderson is in a mistake, where he says, it is totally unflammable; for wherever it is suffered to become so thick as to admit of being dug for fuel, it is just as inflammable as any moss of equal thickness. The only thing which keeps it from attaining greater depth is the want of moisture. But in any little patch where the water happens to be detained, the moss deepens and becomes more complete. While one half of the herbage consists of rich grasses, and the soil not much overcharged with moisture, it is impossible that the moss can attain to perfection. It can only be considered as semi or imperfect moss; in a sort of middle state between complete moss and black friable mould.

Moss of this description, provided the subsoil is not completely barren, and the altitude too high for the growth of grain, is highly favourable for cultivation; as will be noticed in course.

Of the plants which grow on Hill moss, and of which it is formed, heather (*Erica Vulgaris*) is the most common, intermixed sometimes with the Bell heather (*Erica Tetralix*) and in some few places with fine heather (*Erica Cinerea*). The prevalence of this plant induced Dr. Walker to term this description of soil Heath peat, believing that it was chiefly formed of the roots and stems of this plant. In the former publication, I objected to this term as a distinct species of moss, because that plant, being extremely slow in its growth, slow in decay, and of a small stature, it could not contribute much to the formation of moss-earth. It has grown in many places, probably since the commencement of vegetation, without any moss-earth being formed over the original soil; and I did not suppose that the thousandth part of any moss was composed of decayed heather.

The Rev. Dr. Rennie seems to think that I have underrated the proportion which this plant contributes to the forma-

tion of the moss strata. He admits, however, that "in dry
 "moorish grounds, heath is slow in its growth," but he quotes
 M. De Luc, to shew that "in the plains of Twickle, heather
 "promotes the formation of peat." I am well satisfied that
 heather promotes the formation of peat, when it grows on that
 soil, but I never imagined that it formed so considerable a part
 of any moss as to give name to a species; nor am I yet con-
 vinced, that it has any claim to such notice. Dr. Rennie in-
 deed states, on the authority of M. De Luc, that when pits
 had been dug in moss, to the subsoil, and these pits filled with
 water, "Heath springs up spontaneously and with *great rapi-*
 "dity in these pools, and this water and heath contribute their
 "part to the formation of new moss in such places, and that
 "even the rain water which falls on the heath, when allowed
 "to stagnate, leaves a sediment similar to moss."

Never having seen the mosses, the heather, nor the rain
 waters of Twickle, I can say nothing concerning them. My at-
 tention has been confined to the mosses of Britain, and I can
 say, with confidence, that I have never seen in any one of
 them, heather growing in a pool of water. I never understood
 that it grew any where "with great rapidity," that water con-
 stituted any part of moss-earth, or that rain water deposited a
 sediment similar to moss earth.

I readily agree with Dr. Rennie, that heath may be, and is
 detected as a component part of "many mosses," I would even
 say of all mosses on which it was grown. But I humbly ima-
 gine, that he has far over-rated the extent of its contributions,
 when he estimates the one half of a moss, four or five feet
 deep, to be composed of heath. There are few things con-
 nected with moss, which I have investigated with so great at-
 tention, as the plants which it produces, and the amount which
 each of them contributes to the stratum; and I have never
 seen evidences to convince me, that the tenth part of what Dr.
 Rennie mentions, was, in any moss whatever, composed of the
 remains of heather. Where the heather has lost every trace
 of organic texture, it becomes difficult to form an exact esti-
 mate of the extent of its contributions to the formation of the

moss-earth. But where it remains entire, a juster estimate can be formed; and I can assure him, that in any I have examined, the heather does not amount to the hundredth part of what he calculates upon.

He quotes Williams, where he says, "A foot and a half of the surface consists *entirely* of the branches, roots, blossoms, and seeds of heather, apparently not in the least decayed; the second stratum below this is the same, only beginning to decay." This he says is a description of Moss Flanders, Moss Kenshaw, Solway Moss, and most of the Highland Mosses.

I know nothing of Kenshaw Moss, but I have several times surveyed Moss Flanders, Solway moss, and many hundred miles of mosses in the Highlands of Scotland, and I can say with the greatest certainty, that I never saw, in any one of them, or in any other, a stratum, eighteen inches, or even the half of that depth, consisting *entirely* of undecayed heather, and under it another of equal depth beginning to decay. Neither have I seen heather growing luxuriantly in a pool of water. I have travelled several thousands of miles, for no other purpose than to examine every thing regarding the formation, aspect, state, and cultivation of moss-earth, and I never saw one or other of these phenomena.

As heath grows plentifully on the greatest part of hill moss, and as that, like every other plant, agreeably to the laws of nature, dies and yields to the dissolving powers of putrefaction, it certainly must contribute something, more or less, to the formation of the moss stratum. In what proportion, I will not offer an estimate. As the heather is as bulky often on hill moss, as on any other description of moss soil; and as few of the most bulky of the moss plants grow on such situations, there is no doubt a larger proportion of hill moss, composed of heather, than can be in bent or flow moss, to which only I referred in the former edition. But still I am confident the authors whom Dr. Rennie has quoted, far over-rate the proportion of heather in any moss whatever.

Next to the heather, the yellow fogs, as they are usually

termed by the country people, are most abundant on hill moss, particularly the *Hypnum Rutabelum*, *Hypnum Filicenum*, *Bryum Scoporum*, *Lichen Rangiferanus*, *Polytrichum Commune*, and in the wettest places, sometimes a few tufts of the *Sphagnum Palustre*.

These plants are not nearly so bulky as the heather, but as many thousands of their stems rise round every sprig of heather, and as many crops or generations of them attain perfection, in the time which a stem of heather takes to arrive at maturity, I have no doubt but these numerous plants contribute much more, in the course of a century, to the depth of the moss stratum, than the heather, though it appears more bulky than all of them.

The stool bent (*Juncus squarrosus*) and white bent (*Nardus Striäti*) are often found on the hill moss and contribute their part to its formation. These plants are bulky in foliage and stems, and their roots are the most bulky of all the plants which grow in moss, except the *Eriophora*, or some of these which grow in Lakes. Their stems and foliage are wiry; and few, even of the moss plants, more powerfully resist putrefaction.

Tormentilla abounds in hill moss, and contributes its part to the formation of that description of moss-earth. Its foliage and stem are not bulky, but its roots are of considerable size, and the antiseptic quality, which it possesses, will not only resist the powers of putrefaction as to itself, but by being communicated to the other plants and to the moss-earth, it will increase the insolubility of the whole.

Besides the plants that have been named, some of the *Gramina* are always found on hill moss. The *Anthoxanthum Odoratum* and *Holcus Lanatus* are never wanting on that description of soil. *Cynosurus Crisfatus*, some of the coarsest of the *Agrostes*, *Festucæ*, &c. *Plantago Lanceolata*, and many other plants that are eaten and much relished by cattle, grow on hill moss.

SECT. IV.

OF BENT MOSS, and the plants which grow upon and contribute to its formation.

BENT moss differs in its aspect and qualities from the hill moss, which has been described, and from flow moss, to be afterwards noticed. Bent moss is much deeper, much more solid, and cohesive, and bearing a more closely matted sward than hill moss; but not nearly so deep, so soft, or so rough on the surface as flow moss. It is always covered with a close carpeting of coarse green herbage, mixed with some of the moss fogs (*Hypna*, &c.); is firm and solid, supporting the feet of men and of cattle, at all seasons, and is from about six inches to two feet in depth.

If we consider the value and extent of the soil it covers, or the utility of the moss itself, as a pasture, an improveable soil, or as being convertible into manure, bent moss is a subject highly interesting.

Like hill moss, it is found on the sides and skirts of hills, and reclining lands, and generally forms a margin round the outskirts of all flow mosses in Scotland; but does not seem to prevail in England. Being the most solid and cohesive of all the different kinds of moss, either when it remains in its natural state, or when cut into peat, it forms the best and most durable fuel. Being always covered with a close matting of coarse grasses, and rough bulky green herbage, and but little encumbered with heather, it makes tolerable pasture, and is, of all other descriptions of moss or moor ground, the most propitious for cultivation.

Bent moss generally rests on a subsoil of clay or loam, or on a soil more retentive of moisture than the sandy or other open soil, found under hill moss. It is probable that the difference between these two kinds of moss is chiefly, if not altogether, owing to the diversity of the subsoil. When the bottom is retentive, a considerable portion of moisture is detained on the

surface, the aquatic plants grow more luxuriant, the richer grasses are drowned, the course of putrefaction is retarded, and the moss stratum deepens. Hill moss, bent moss, and flow moss, are often found in alternate patches; the former on the steepest parts where the soil is meagre, and a scanty portion of moisture is detained, or in places more level, or where it percolates the subsoil; bent moss, where the declivity is not so great, and the soil more retentive of moisture; and the flow moss, on level ground, or where by the fall of trees or other obstructions, a still greater portion of water has been detained on the surface.

As trees are frequently found under bent moss, the origin, at least of some part of it, may fairly be attributed to the overthrow of the forests. As much of it rests on ground having considerable declivity, the overturning of the trees in such situations would not create such a stagnation of water as in places more level. The moss-earth would not accumulate so fast, and even the trees which lay on the soil would rot and be dissolved before moss-earth rose so high as to cover them. In situations much exposed, and where the soil is of no great depth, the wood would be stunted, and far from being so bulky as in places better sheltered. From that circumstance, and the declivity of the ground, the stagnation of air and water would be small in comparison with that in other places where the ground was more level, and the trees more luxuriant. Hence flow moss would rise on the one, and only bent moss on the other.

Even where no wood actually fell, the origin of the Bent moss may be traced to the overthrow of the forests in the neighbourhood: or if these did not immediately lead to the formation of such moss beyond the spot on which they rested, they would at least accelerate its growth when once introduced.

The huge bodies of dead damp chilling moss, formed over the prostrate wood, and the blasting damps and nipping frosty vapours which proceed from such mosses, would check the growth of the rich grasses in their vicinity, render the soil moist, and gradually introduce the aquatic herbage. These coarse grasses being less palatable would remain unconsumed by the cattle,

and in proportion to the degree of cold, and humidity of the soil, the leaves, stems, and roots of these grasses, would resist putrefaction, until they collected on the surface, in the shape of moss-earth over the original soil. A damp soil and chilling atmosphere always banish the succulent grasses, and raise in their stead, a coarse and unpalatable herbage. The acids, tan, and other qualities which they possess, enable them to resist the dissolving powers of putrefaction, and they remain on the soil, under a partial decay, in the shape of moss-earth. The substances of which they are composed being thus locked up, the soil is not enriched, in the same manner as it would be by the complete dissolution of the former crop, and it becomes every year poorer, and the crops coarser. The remains of the former crops being locked up in cold torpid earth, instead of promoting, greatly retard the growth of new crops. As that half decayed substance accumulates on the soil, the herbage becomes gradually coarser, the soil more humid, and the cold more nipping. All these evils serve to increase each other; the cold and the damp increase the quality of the half decayed vegetable matter on the soil, and that matter increases the cold and damp.

Moss plants, like all other vegetables, are furnished with powers to multiply and extend themselves over the face of the earth. The command to be fruitful and replenish the earth was not confined to the human species, but evidently reached to every subject of the animal and vegetable kingdoms of nature. To enable them to obey that command, the most ample powers are conferred. Moss plants not only propagate their species by dispersing their seeds or extending their roots, but even when they have ceased to grow, they accumulate on the soil in the form of torpid earth, and by sending forth their chilling vapours, blast the richer grasses near them, and thereby extend their own species, over a greater range of surface.

But bent and hill moss may both be formed where no wood has been cut, either on the particular spot, or in the neighbourhood. Where the soil is thin and meagre, destitute of calcareous earth, vegetable matter, or any enriching and fertilizing sub-

stance, where the bottom is retentive of moisture, and where the hand of the cultivator has not reached, the growth of the succulent herbage is not to be expected. The coarser plants only can maintain their footing; and these once established, and the richer plants banished, they increase from time to time in the manner which has been mentioned, till they form a stratum of earth over the original soil, and that thickens in proportion to the quantum of moisture detained on the surface.

The formation of ridges has a tendency to retard the growth of the moss plants, and the speedy accumulation of moss-earth; but they do not present an unsurmountable bar to its formation. Ridges have been found under moss of a great depth, as has already been noticed. I have seen not only the *Carices*, *Junci*, *Hypna*, and other forerunners of the moss tribes, but even the *Polytrichum Commune*, *Sphagnum Palustre*, and *Bryum Hypnoides*, the *Ericae*, and others the rankest of the moss plants, growing on land in the Baronies of Hamilton and Dalsersf, on the banks of the Clyde, which were cropped with grain, in the memory of people yet alive. If these are neglected as they have been, they will ultimately be covered with bent moss.

All the plants which have been mentioned as growing on hill moss, with the exception of heather, are also found on bent moss, and contribute largely to its formation. Bent moss being covered with a bulky sward of green herbage, heather is not found on it, in any considerable quantity. Perhaps too, a smaller proportion of the yellow fogs (*Hypna* *Rutabulum* et *Filicenum*) grow in the generality of bent moss than in hill moss. The white fog (*Lichen Rangiferanus*) is also more scanty in bent moss. But all the others that have been named abound as much on bent, as on hill moss. All the rushes (*Junci* et *Scirpi*), *Nardus Stricta*, *Juncus Squarrosus*, and Sedges (*Carices*) are more numerous in bent than in hill moss. With these are mixed several of the gramina, particularly they that have been already named as Generally found on hill moss, and also the *Melica Cerulea*, which in Airshire, and some of the neighbouring Counties, is by the country people called blow-

ing grass. Most of those who have written on moss either assert or insinuate that it is formed of that order of plants termed Musci, by Botanists. But it will be found on inquiry, that though some few species of that order are found growing on some mosses, they add very little to the body of moss-earth, and that the plants which grow upon and chiefly contribute to the formation of the moss strata belong to several different classes and orders of vegetables, according to Botanic arrangement. To name the whole would be of no use to those who are strangers to Botanic terms, and such as are acquainted with the nomenclature of that science know the fact here stated.

SECT. V.

Flow Moss described.

THE third and last species in the foregoing arrangement is that of *Flow Moss*; or what Dr. Walker thinks ought to be termed *Flaw moss*, from a word of Saxon origin.

Flow moss is a term familiar to all ranks in Scotland and England, with which I am intimately acquainted. It is every where understood to mean a deep bed of soft moss-earth, abounding with moisture, yielding a scanty supply of coarse herbage, and presenting to the eye a rough and unsightly aspect. It seems to be moss in its highest perfection; is always deepest and most complete on low level ground; but is often met with of great depth, where the ground has considerable declivity. Its surface is always rough, abounding with many tufts or hillocks, intersected with stanks, gutters, or hags of various depth. As those gutters do not support a man's foot, the traveller on flow moss is fatigued with leaping from one hillock to another.

Flow moss which is level, is so much overcharged with moisture, as to bear the foot of a man only where the sward is strong. Where the ground has much declivity, these mosses

are generally from six to ten feet in depth ; where the declivity is less, it is from ten to twenty feet deep, and in level situations it has been found from forty to fifty feet in depth. Some flow mosses are so much distended with water, that they cannot be cut into peat. Being composed of the worst of moss plants, and overcharged with moisture, putrefaction makes very small progress ; of course they make very bad peat, and are not well adapted for being formed into manure, or an improved soil. Hill and bent moss cover much greater extent of surface than flow moss ; but in solid contents the latter far exceeds both the former. Such being the condition in which we find flow mosses, and the aspect which they present to our view, it will be proper to inquire into the means which have led to the formation of that singular and unsightly substance.

The greatest part of the deep flow mosses in Britain have undoubtedly been formed over felled wood ; in some places they have supplanted lakes or stanks of water, and perhaps in some parts they have proceeded from other causes. I shall inquire into each of these formations in their order.

SECT. VI.

Of the formation of Flow Moss over prostrate wood.

1st. The existence of woods in Europe proved.

To render the origin of the greatest number of our deep mosses plain and obvious to the meanest capacity, as well as to refute the fanciful theories which have been mentioned, it is necessary to observe, that, as far back as authentic history reaches, nothing is better attested, than that by far the greatest part of the surface of Great Britain was covered with growing forests. Woods and forests covered so much of the surface of Great Britain at the time the Romans invaded that Island, that it was common for their historians to represent it as " Hor-

rida Sylvis," (fearful with woods.) The names of the forests, recorded by the Romans, are numerous, and many of them are known to have covered extensive ranges of country.

The forest *Anderida* was one hundred miles long and thirty broad. *Sylva Caledonia* was of still greater extent, covering all the hills and central places of the Highlands of Scotland. The forest of Selkirk, which remained to a recent period, reached from the town of Air, to the Lammer Muir. That of Jedburgh, which was joined to it, covered large tracts on both sides the Tweed. The forest of Coritani, stretched over large tracts of the Counties of Lincoln, Nottingham, Derby, Leicesters, Rutland, and Northampton. Another forest on the south of England, was more than one hundred and fifty miles in length, extending from the County of Kent to that of Somerset. The forest of *Arden* round Muncunium (now Manchester) was of vast extent; and those of Pendale, Rossindale, Blackburn, &c. covered immense ranges of hills and dales.

Such as have read the Roman historians, correct translations of them, or authentic histories written on their authority, must have noticed that woods and forests were not peculiar to Britain, but abounded in almost every part of the Continent of Europe; as they still do in the uncultivated regions of America, and in some parts of the north of Europe.

The *Sylva Arduenna* of Gaul, as described by Cæsar, the conqueror and accurate historian of that country, was upwards of five hundred miles in length, reaching from the Rhine to the conflux of the Maese and the Scheldt. Strabo, Ortelius, and other Roman historians corroborate Cæsar's account of these forests.

It appears from the concurring testimonies of Cæsar, Pliny, Pomponius, and others, that the Hercinean forest alone, covered nearly the half of Germany. Besides that, Ptolemy delineates in his map of Europe, *Gabrielia Sylva*, *Somana Sylva*, *Helvetiorum Sylva*, which leaves but a small proportion of the north of Europe free of forests.

But if any person should not have seen these authorities, or be disposed to doubt them, they may find the accounts of

the Roman historians corroborated by testimonies more recent, nearer home, and much more familiar to their own ideas.

In all parts of Scotland, fields, farms, estates, baronies of land, whole parishes, and even larger districts of the country, are to this day named by wood, forest, or something which proves that they were at one time covered with trees.

The name *forest*, is not peculiar to those of Selkirk, Etterick, Paisley, Mauchline, &c. but is to be met with in every county, and almost in every parish of Scotland. We find it under various descriptive modifications, as Easter forest, Wester forest, High forest, Laigh forest, Black forest, Great forest, &c. &c. It is also to be met in all parts of England, even where growing wood is not now found.

Wood is every where a common name for fields, farms, &c. where no remains of woods can now be traced, unless under the mosses. To enumerate the instances which I could put down from memory, would fill many pages. They are so numerous, that almost every term in our language is used to distinguish their varieties of altitude, direction, colour, dimensions, and other descriptive peculiarities: as *Highwood*, *Laighwood*, *Blackwood*, *Eastwood*, *Northwood*, *Greenwood*, *Greatwood*, *Littlewood*, &c.; and from the materials of which they were composed, as *Birkwood*, *Alderwood*, &c. They are also distinguished by the names of the birds or animals which inhabited them, as *Hartwood*, *Harewood*, *Hawkwood*, &c. We have *Woodhead*, *Woodend*, *Woodside*, *Woodhill*, *Woodburn*, with many other names of a similar import, as *Trees*, *Treesbank*, and *Bank*, which we modify into *Bankhead*, *Bankend*, *Linbank*, *Birkenbank*, &c. All these are pure English names, which shew that these woods, and forests, had existed after the introduction of that language into Scotland.

We have many such names in the Celtic tongue; such as *Shaw*, which is the word used as the name of wood in that language. From that we have not only places named *Shaw*, in all parts of Britain, but many other modifications of that term, as *Shawhead*, *Shawfoot*, *Shawton*, *Shawtownhill*, *Shawfield*,

Stagshaw, Hartshaw, Hareshaw, Laighshaw, Bowshaw, Bonshaw, Aldershaw, Birkenshaw, Oakshaw, &c.

Calder is the Celtic term for wood and water, and many of our streams of water, or rivers, bear that name. From that we have *Calderhills, Caldercrooks, Calderbanks, Calderbeughs, &c.* innumerable. *Coille* is another term in the Celtic language for wood. A large division of Airshire bears that name, or *Kyle*, which is a corruption of the word; and in that District the remains of the natural forests may still be seen on the banks of the river Air, the *Coille*, a river which falls into the Air, and other parts in that neighbourhood. We have many other places in Scotland named *Coille* or *Kyle*. I understand that *Selkirk* denotes the woody district, and *Caledonia* bears the same meaning. But further instances are unnecessary, as every inhabitant of Scotland or England may be able to point out such names. It was not without the most satisfactory evidence, that our historians describe Britain, as very much covered with wood. Mr. Heron very justly observes, that "in the commencement of the first periods of its history, the country of Scotland was universally overgrown with woods, except on the verge of the shores; on the brinks of some parts of the course of its rivers; on the cliffs of its rocks, destitute of soil, and unfit to nourish vegetation; in some low tracts where the stagnation of the waters, the decay of trees, and other vegetables had already formed morasses; and in a few narrow spots here and there, where the natives had perhaps felled a tree to make room for a hut, or to use it for domestic purposes."

The Rev. Dr. Rennie, who has made strict research into every thing respecting the state of the mosses on the Continent of Europe, has shewn (page 67th) that "*Wolde, Wood, Wode, Waelde*, all mean the same thing. They correspond to our English word *Wood* or *Forest*. All mosses on the Continent which bear this name, such as the seven Wolden of Friesland, &c. and those in the British Isles, such as Lincolnshire Woldes, the Waelde of Kent, &c. &c. may be included in the above list."

"Innumerable mosses on the Continent are called *Holt*, or *Hout*, or *Boom*, or the names of them include those monosyllables. All of them signify the same thing, viz. *wood*. *Holt*-land or *Holland* is the woody country. *Boomen*, &c. &c. signify the same."

"The names of many mosses on the Continent are descriptive of those particular species of trees which prevailed in the forest while it stood, and which may now be traced in its ruins. *Note Boom* is the Hazel or Nut tree. *Ebzen boom* is the ash, *Eyken boom* the Oak; *Piin boom*, the fir; *Birken boom* the Birch; *Pein boom*, the Pine, &c. &c. All the mosses therefore bearing these names, must not only have originally been forests, but forests abounding with that distinct species of trees whose names they bear."

That all these in every part of Britain, or on the Continent, and all the other places which bear names signifying wood or forest, in whatever language, were, when these names were conferred, covered with growing trees, as the names imply, cannot admit of a doubt.

Those immense forests, which, in former ages, covered and beautified Scotland, have long since been extirpated. The only traces of them now to be met with, are either in the page of history, the names of the forests, still attached to the fields on which they grew, or, where moss has risen over them, some remains of them are yet to be found. Many of the fields where these trees once grew, have been brought under cultivation, but others are buried under deep beds of moss-earth, of which, the overthrow of those widely extended forests have led to the formation.

2. *The overthrow of Woods inquired into.*

THE existence of the forests being thus established, the means by which they have been destroyed, and the manner in which their overthrow has contributed to the formation of moss-earth, where none had existed before, fall to be inquired

into. On this subject, I shall follow my usual method, viz. first, consider what has been said by others, and next offer my own opinions on the subject.

An ample and correct account of the overthrow of these forests, has not been preserved, and cannot now be obtained. Nature and art seem to have united their force to extirpate those extensive and beautiful woods, the shelter and ornament of the earth : for both are provided with powers to overthrow every plant, as well as every living creature. The stately oak, "the monarch of the wood," the beauty and pride of the vegetable kingdom, is, in spite of all his moorings, sometimes overthrown by the angry tempest. If he escape that catastrophe, he is at last conquered by all-subduing time. If a breach is once made in a forest, the whole may soon be overthrown by the winds. As trees growing in a thicket shelter each other, they rise high, and do not put out so many roots, as a single tree does, which grows in an exposed situation ; so that if a breach is once made, the whole may easily be overthrown. That some parts of these forests were thus overturned by hurricanes, at different periods, is highly probable. Though I do not imagine that many of our forests have been overturned in that way.

Some who have written on moss, pretend to have discovered, that the tops of fossil trees, in the western parts of Scotland, are always found pointing to the north-east, and from this they conclude, that the forests have been overthrown by the south-west gales, which are always the most powerful in that part of the island. The venerable Dr. Walker has, among others, gone into this error ; Prize Essay, pages 18 and 19, he says ; " We find in them (mosses) large full grown trees, but " always evidently broken over, and without the bark. In " remote times, when timber was of no value, the trees re- " mained to the very last stage of decay, when they were " thrown down by the winds. Trees found in peat strata, " generally lie one way, or in the same direction ; a presump- " tion that they have been blown over by the same wind. In " the Locher moss, and other extensive mosses in the west of

"Scotland, the trees all lie with their tops directed to the north and north-east. And it is well known, that all the great storms of wind, on that side the island, come from the south and south-west." But he adds, that in Holland, where the strongest gales proceed from the north-west, the fossil trees point to the south east.

Had Dr. Walker duly examined fossil wood himself, he would have found trees lying with their tops in every direction. I have carefully surveyed many mosses, in all the counties of Scotland, and in several of those in England, without being able to say towards which point of the compass the greatest number of trees had their tops pointed. I have seen some trees that had evidently been broken, and a few with their roots adhering, which seemed to indicate that they had been overthrown by the force of the winds. But these instances are so rare in the mosses I have seen, and the roots of the trees in their natural position, so numerous, that I am confident the woods have, for the most part, been thrown down by the hand of man. The only trees in the western mosses that have not been cut, but seem to have been blown down by the winds, are the birches, and other aquatics, which have not grown in the original soil, but in the moss, after it had risen several feet high. These are generally but stunted and shabby, and they are always found with the roots adhering. But most of the large trees that grew in the sub-soil, will be found to have fallen by the axe.

But even supposing the greater number of the trees in any particular moss, to be found with their tops pointing one way, that of itself is no proof of these trees having been overturned by the wind. The same thing must have happened, if they were cut with the axe or saw. Their tops must have fallen towards that side or place of the forest, where the operation of cutting commenced. As the growing trees would prevent them from falling towards the uncut wood, they would only fall in the contrary direction.

Dr. Walker, in the passage above quoted, appears to me to be in an error as to the manner in which the woods were

thrown down. He seems to think, that the whole trees of a forest would arrive at old age, and all of them die at one time. This is by no means the case. In a forest, as in animal life, one generation succeeds another. While one tree dies of old age, others are springing up at its side, or from its roots; and the forest is a forest still. One generation of trees succeedeth another, but the wood still remains.

But supposing, as the writers on moss generally assert, or insinuate, that the whole trees of a forest, or even a large district of it, should, like a crop of beans or of hemp, all come to maturity at one time, and all of them die together, I very much doubt if the formation of a moss was at all likely to follow. If a wood should die in that manner, the leaves and small branches of the trees would drop off one after another; the larger branches would follow, and the trunk would in time crumble down. But when these fall piece-meal, the smaller and least durable parts of the tree would be dissolved into earth, before the great and massy trunk of solid red-wood yielded to the force of the winds. In that case, a moss was not nearly so likely to be formed, as when the wood was cut or overthrown, when the trees were entire, and in the vigour of their growth.

But, however that might turn out, I am confident that none of the mosses in the west of Scotland, have been formed in the way the learned doctor mentions. I have carefully examined thousands of them on both sides of the Tweed, and have seldom found a moss of any great extent, but I saw on the verges of it, where the moss had been removed for fuel, or washed off by streams of water, the roots of trees still in the ground, with their fangs extended in the way they grew. These are to me so many incontrovertible evidences, plain and visible to all, that the trees which grew from these roots, did not die of old age, nor remain standing after dead, till they lost the bark, and arrived at "the very last stage of decay;" but it proves to a demonstration, that these trees were overturned by the axe or the saw. Wood thrown down when in the vigour of its growth, before it is diminished or impaired, is much more like-

ly to occasion that stagnation of air and water, which would change the state of the herbage, and ultimately form a moss, than if they had died, and crumbled down piece-meal.

The venerable doctor is also in an error, as to the bark being allowed to fall off before the trees were overturned. If he had examined fossil wood with attention, he would have found that much of it still retained the bark, at least on the under side. The bark will often be found adhering to the lower side of the tree, or visible under it, when the upper side of the same tree is consumed to near the centre. This proves that the tree was entire when it fell. The under side being soon enveloped in the moss, was preserved from corruption; while the upper side, being many years exposed to the atmosphere, before the moss rose over it, was much more injured. The doctor justly observes, that the lower, or nearer the subsoil, the tree is found, the more entire will it be. The trees that lie higher in the moss, are always most consumed. The reason is obvious, it must have been much longer before the moss, which is but slow of growth, rose so high, as completely to cover the whole tree, and shelter it from the dissolving powers of the atmosphere. Whenever any substance is completely enveloped in moss, the progress of corruption is arrested.

Mr. Nasmith, who wrote after Dr. Walker, sees no occasion for the machinery of the Roman Legions or other military devastators, in cutting down the forest. Neither will he trust to the winds alone for their overthrow. The assistance he proposes is extremely simple, viz. "*By the fall of a tree across the declivity, the current of water and the substance it brought along with it, would be interrupted and a dam formed. The water thus stagnating, by the fall of dead trees, would chill the roots of the living, and they of course would perish, till at length the whole forest would become prostrate on the ground.*"

There may be situations where the fall of a tree might create a stagnation, injurious to the health of a few others around it; but it is not likely that any wood or forest, even of the extent of a few acres, could be overturned and converted into moss, by means so extremely simple as the fall of a tree

across the declivity. If that had converted woods into mosses, no wood could have survived, or could yet exist for a few years; for, there is scarcely a wood or plantation in which some tree has not been overturned by the winds, and fallen across the declivity. Nature does not suffer any species of her plants to be extirpated by such simple means, and much less the trees of a forest.

If the fall of the trees found under moss had been accelerated, by the chilling of their roots, as Mr. Nasmith supposes, the roots would have been found adhering to the trunks; but few trees are found under moss with any part of their roots adhering. At least that bulky knob or lump of wood which is found at the surface of the earth, from which the trunk rises, and the large tendons diverge, would have adhered. That part of a tree which is generally twice the thickness and strength of any other part of either the roots or trunk, is, of all others, the least likely to give way to the force of the winds, or any external force whatever. Mr. Nasmith, however, thinks this part of the tree would be the first that gave way. In a few years, posts of the strongest oak decay near the surface between wind and water. The same cause would, he thinks, produce the same effect on that part of the tree, and supersede the use of the Roman axe. But it was with growing trees, not with posts of dead timber, that Britain was covered. At whatever place the post may soonest rot, it is evident that this part of the tree resists corruption longer than either the top or root. To be satisfied of this, it is only necessary to look at the roots, still to be seen in every moss, almost entire, or at any rate far less impaired than either the tendons under ground, or the trunks of the trees. When a tree dies a natural death without being overthrown, putrefaction and dissolution commence at both extremities, above and under ground. The leaves, twigs, and bark above, and the tender fibres below perish first, and the trunk or bulb which grows on the surface, as it were, between wind and water, resists putrefaction longer than any other part of the plank, either above or below ground. The colonists at Blairdrummond moss, have felt, and others on the Forth,

who have removed the moss to enable them to come at the subsoil have found to their sad experience, that this part of the tree remains entire after the small parts have been reduced by putrefaction. But supposing the dead trees had, like the posts, decayed at the surface, how does Mr. Nasmith imagine that the trees would be deprived of their vegetable life, in order that they might rot between wind and water? A tree overthrown by the winds, will give way in any other part sooner than in that knob between root and stem. The tree will either break near the branches, or the lateral fibres will yield, and the tree fall with the block of wood adhering. The latter must have happened, had the roots been chilled and injured in the way Mr. Nasmith supposes. But few trees are found in that state in any mosses which I have seen.

Dr. Rennie, who must have seen Mr. Nasmith's Essay, takes no notice of this extraordinary tree, whose fall creates a stagnation which leads to the destruction of the whole forest. He seems to think that some aid more powerful was necessary to work such wonders as the extirpation of the forests. That aid he states on the authority of Mons. De Luc, who roots out his forests by an accumulation of moss-earth, formed from the leaves and other offals of the trees, on the surface round their roots and trunks, till the moss softened the soil, and the trees fell an easy prey to the winds. The notion is ingenious, but is not supported with facts to satisfy me.

If the leaves, twigs, and offals of the trees formed a bed of moss, which ultimately overthrew the woods, no forest could exist beyond one crop. Now it is well known that parts of several of the forests mentioned by the Roman historians, remains to this day, almost two thousand years since they pointed them out as in full maturity. Yet in these no vestige is to be seen of this moss which M. De Luc supposes should prove so fatal to forests. If it has not been begun to be formed in forests which have existed for two or three thousand years, where or when are we to look for it? But in Muscovy, Tartary, America, and other countries to which the Romans never carried their victorious arms, and where the woods were

not cut down for any purpose whatever, but remain entire, no such thing is to be found as the moss mentioned by Dr. Rennie's correspondent. These trees must surely have yielded many crops of leaves, and many seeds, twigs, and every thing which the trees now under the mosses referred to by M. De Luc could yield, yet no moss has been formed.

Dr Rennie guesses, a single crop of leaves, falling from the trees of a forest, to form a stratum of moss, one-fourth of an inch in thickness. In five hundred years, he thinks the leaves alone would form a stratum three feet thick; or if blown into heaps, they might form in some places twelve feet of moss. The seeds, twigs, &c. he applies to the same use, till he raises, in a few centuries, beds of moss sufficient to destroy the forest. He thinks he has seen moss-earth bearing evident marks of the remains of leaves.

This ingenious theory of Dr. Rennie's Continental correspondent, does not satisfy me in the manner it seems to have convinced him. When I differ in opinion from authors so very intelligent and respectable, I consider myself bound to assign the reasons which preponderate in my mind. In the present case, these are, first, because I consider the theory they have adopted as contrary to the laws of nature; and secondly, because in the forests of the most remote origin, which still remain in luxuriant growth, no such thing as the moss they suppose, has yet been begun to be formed.

Leaves, seeds and twigs of growing trees, when they fall off in the course of nature, dissolve as fast as the richest grasses. They do not possess the Acids, Tannin, Extractive, or other qualities, which tend to resist putrefaction. They speedily yield to that destroyer of organic texture, and give up the substances of which they had been composed to the elements from which they had been taken. A heap of branches, leaves, &c. if they created a stagnation of water, sufficient to banish the richer herbage, and of course, to introduce the moss plants, might lay the foundation of a stratum of moss-earth; but though they were heaped to the height of twenty feet, if they rested on

a dry place, they would rot, the same as so much grass, hay or straw, and no moss-earth would be formed from the one more than the other. The crops of leaves, &c. which have dropped from the trees every autumn, have not formed one inch of moss on the surface of the ground, under any of these forests in Germany, or in Britain, which are mentioned by the Roman historians, as growing in great luxuriance at the time they wrote. As little do we hear of moss being formed under the forests of Muscovy, Tartary, America, &c. which have remained undisturbed since the commencement of vegetation.

Dr. Rennie says, he has seen, in the moss-earth, something resembling leaves. Something resembling leaves may also be seen in coal, and the figure of plants, shells, Fishes, horns, &c. are seen in limestone. Something resembling vegetation may be seen every frosty morning on the inside of every pane of glass in our windows; yet we all know that these phenomena have no connection whatever with any description of vegetables. But as the woods were cut by armies, which do not take the fields in winter, it is likely the trees were in leaf when cut down; and though these leaves were as soluble as those now growing, yet, the stagnation of water which the fall of trees would occasion, and the bulky herbage it would instantly raise, would, with the Tan in the bark, &c. arrest the progress of putrefaction, and preserve some remains of that crop of leaves; which must have been those which Dr. Rennie has seen.

Dr. Rennie says (page 63d) that in the mosses on the Continent, in the Isle of Man, and in the marsh of Connaught, trees are found standing erect as they grew; the roots firm in the soil, and the trunks rising eighteen or twenty feet in the moss stratum.

The Rev. Doctor cannot have seen these himself, and he does not say on what authority he mentions them. Few things have been stated concerning that substance which to me seem more unaccountable. I do not conceive it possible, that the leaves, twigs, and other offals of any woods or forest could ever form moss-earth over the original soil; much less that in any case whatever, it could have risen to the tenth part of that

height. In these cases the growth or accumulation of the moss-earth, must have been very rapid. Two or three feet of moss over the roots of the trees, would not loosen the earth as Dr. Rennie's correspondent thinks, but it would kill their growth. Now supposing the moss to be six feet deep before the trees died, how is twelve or fourteen feet of new moss to be added to the stratum, before the trees, exposed to the weather, rotted down. The moss-earth could only preserve what it enveloped, not what remained exposed above its surface. And, supposing a tree to hold out against wind and weather for a century, the growth of the moss must have been very rapid indeed, to have, in that time, risen twelve or fourteen feet. But as I am confident that no moss-earth was ever formed six feet, or even one foot deep, under a *growing* forest, the growth of the moss must have been wonderfully quick if it rose eighteen or twenty feet, from the time the trees died, and before they rotted and were overthrown by the wind. If it continues to rise with the same rapidity, it may, before the final conflagration, rival the Alps or the Andes in height.

The only way in which I can account for trees being found erect, twenty feet high in moss, with their roots still firm in their native soil, is, that *the moss has been water-borne*. Some semi-liquid moss in a high situation seems to have bursted, been floated off by water, and rested among the growing trees in some low situation to the depth of twenty feet. Many instances of mosses so floated off might be mentioned. That of the Solway moss is the most recent in Britain. It was carried by the water to a considerable distance, and heaped up, in some places, to the height of fourteen feet. Had the Haughs of the Esk, where this moss was deposited by the water, been a growing forest, the trees would have been covered up, at least to the depth of fourteen feet, and probably still deeper, by the transported moss. In that case the matter is perfectly obvious and simple; in any other, it is a phenomenon for which I cannot account.

Fire is another of the instruments, which some have imagined has been used in destroying the ancient forests. The evi-

dences of it are still visible on some of the trees which are dug from under mosses, several of which retain in Scotland the name of *Burntwood*. I am now of opinion, however, that this mode of destruction of the forests must be understood with greater limitation than I once thought.

That a plantation composed chiefly of firs, from about twelve or fifteen years growth to that of thirty or forty years old, when planted near each other, and abounding with withered branches below, may, during the drought of spring or summer, be set on fire, and that, with a moderate gale, the flames may be communicated from one tree to another, till the whole plantations situated to the leeward of the flames, are injured or consumed, cannot be doubted. But my belief as to the destruction of forests by fire, does not now extend much farther. I have never known, nor do I conceive it possible, that a wood composed of Oaks, Ashes, Elms, Saughs, Elders, Birch, &c. (unless mixed with a considerable proportion of dry wood, firs, whins, &c.) and where the trees are any way nearly full grown, will at any season of the year, easily take fire, or burn to great extent even when set on fire. Trees, in the luxuriance of their growth, will not easily be set on fire, and the distance at which they grow from each other, would prevent the fire from spreading far, if they should be kindled. A single tree, when dried and set on fire, will scarcely burn even under the cover of a house, unless it is cut in pieces or some combustible matter added. Green trees, at the distance they grow from each other, must be still less inflammable.

All the plantations of firs I have ever seen burnt, were in consequence of fires having been kindled in whins, heather, or something more inflammable. Even in that case, though the under dry branches of the firs were consumed, and the trees rendered incapable of future growth; yet I never saw that much of the trunks or greener foliage was burnt. I have even seen firs growing after the fire had passed over them; and I never knew such an accident happen but in very dry weather, in the latter part of the spring or beginning of summer.

I have often met with trees, or pieces of trees, under moss,

periority chiefly consisted. *Caesar* informs us, that *Cassivellanus*, after his defeat, sought refuge in the woods and marshes. When *Agricola* defeated the inhabitants of *Bodotria* (*Fife-shire*) their retreat was covered by the woods and fens: and *Tacitus* says, that the *Silures* and *Brigantes* followed the same course.

The Britons often sallied forth from these strong holds, and attacked, with the fury of tigers, the Romans, when off their guard. By such sudden and secret assaults, they sometimes made themselves master of much booty, and cut off many of their enemies. But such was the ambition of that wonderful people to acquire military fame, and subject the whole world to their yoke, that they actually undertook the extraordinary task of cutting down the forests, and draining the lochs and swamps in Britain. The Emperor *Severus* in his last expedition, about A. D. 207, and during the reign of *DONALD*, the First, in *Caledonia*, gave orders, to cut down the whole forests in Scotland, and it is well known that large tracts of them, were at that time thrown down, and that deep mosses have since risen over the felled trees. *Severus* not only employed the Roman Legions, and auxiliary troops then in Scotland, but also compelled such of the natives as had submitted to the Roman yoke, to assist in that herculean labour. *Herodian* mentions the fact, and *Dio Cassius* says, that the Emperor lost, in that Expedition 50,000 men, in cutting the woods of Scotland, without ever facing the natives in battle *. *Galgacus*, in the speech he made to the soldiers, before the famous battle he fought with *Agricola*, as recorded by *Tacitus*, complains, that the health of the Britons was perpetually exhausted in the painful employment of clearing the woods, and pav-

* "SEVERUS entered Caledonia, where he had endless fatigues to sustain, forests to cut down, morasses to dry up, and bridges to build. The waters too extremely incommoded his troops, insomuch that some of the soldiers being able to march no farther, begged of their companions to kill them, that they might not fall alive into their enemies' hands. In a word, Severus lost no fewer than fifty thousand men in this Expedition, though he fought no battle, and saw no enemies in a body."

ing the fens of the island. With justice therefore it might at that time be said,

“ Loud sounds the axe, redoubling strokes on strokes,
On all sides round the forest hurls her oaks
Headlong: deep echoing groan the thickets brown;
Then rustling, crackling, crashing, thunder down.”

WHITAKER'S HISTORY OF MANCHESTER.

An instance in point, shewing the manner in which the Romans went to work in destroying the forests of Britain, is recorded in a paper in the Philosophical Transactions, No. 275, respecting Hatfield forest.

“ That the Romans did destroy great woods and forests, in these moors, marshes and bogs, I now come to prove. The common road of the Roman armies, was from south to north, by Lindum (Lincoln) to Sigiculum (a little borough upon Trent) from thence to Donum (Doncaster) where slept a standing garrison of Crispinian horse. On the E. and N. E. of the road between these two last named places, lay the borders of the Great forests. These swarmed with wild Britons, who were making continual sallies from the same, and retreating to them again; intercepting the provisions of the Romans, and destroying their carriages; killing their allies and passengers, and disturbing their garrisons. This at length so enraged the Romans, that they were resolved to destroy the forest. That they might do it more effectually, and easily, they marched with a great army against the same, and encamped on a great moor near Tinningly, as appears from the fortifications that may be still seen.

“ Near this, it is probable that a great engagement took place, for hard by it is a little town called Osterfield. Now as *field*, the latter part of the word, is never used to be added to any other than where there has been a battle; so *Oster*, the former part of the name, seems to tell us what Roman General it was who fought, viz. the famous Ostorius, who, all the Roman historians assure, was in those parts.

“ Who got the victory is not easy to say. No doubt it was the valiant Romans, who, besides the multitudes of the Bri-

" tons whom they slew, drove the rest into the woods and
 " forests which covered this low country. Therefore, the
 " Romans, that they might destroy the enemy more easily,
 " took an opportunity of a strong south west wind, set great
 " fires to the forest, which taking hold of the fir trees, burnt
 " like pitch and consumed infinite numbers of them. When
 " the fire had done what mischief and execution it could,
 " the Romans brought their army nearer, and with whole
 " legions of captive Britons, chopped down and cut most of
 " the trees that were left, leaving only here and there some
 " great ones untouched as monuments of their fury.

" These being destitute of their under wood and neigh-
 " bouring trees were easily overturned by strong winds. All
 " these trees falling across the rivers that formerly ran
 " through that low country, soon dammed up the same, and,
 " turning it into a great lake, gave origin to the great turf-
 " moors that are there, by the gyrations of the waters, the pre-
 " cipitation of terrestrial matter, the consumption and putre-
 " faction of broken boughs and branches, the vast increase of
 " thick water mosses, which wonderfully flourish and grow up-
 " on such rotten grounds.

" Even now since the drainage, and since that ground was
 " laid dry for many miles, they are so surged with waters,
 " and so soft and rotten, that they will scarcely bear men to
 " walk on them.

" Hence, old Roman coins, axes, &c. have been found near
 " the roots of the trees, that lie at the bottom of these moors
 " and levels.

" Hence too, on all those grounds, great numbers of trees
 " are found burnt, some in two, some length ways, and some
 " chopped and hewn.

" Hence some are found with their roots, and others, as
 " they have lain all along, have branches growing out of their
 " sides.

" Hence they lie by their own proper roots, with their tops
 " to the N. E.

" But to return to the Romans; as they were the destroyers

“ of this forest, so were they likewise of all the others that
 “ grew on the low countries of Cheshire, Lancashire, York-
 “ shire, Lincolnshire, Staffordshire, Somersetshire, &c. &c.
 “ Yea, and of the countries beyond the seas, where such trees
 “ are commonly found.”

If further evidence were necessary to shew that many of the British forests were cut down by the Romans, such evidence might be found in the great variety of Roman works, utensils, and coins which have been found under mosses since accumulated over the woods that were cut down by that industrious and enterprising people.

A Roman causeway or road had, ever since the Romans departed from Britain, been visible on the south side of Kincardine moss, at Craig Forth, and upon the north of the moss near the river Teith; but for many ages past, the people in the neighbourhood were of opinion that the road was interrupted by the moss. In digging up and floating off the moss, however, the road is found entire under it, to the depth, in some places, of ten feet. The road is twelve feet broad, its bottom, which rests on the subsoil, is formed of trees, from eight to twelve inches square, laid close together in the direction of the road; over these smaller trees are laid in a transverse direction, and a course of brush wood over all.

The Rev. Dr. Rennie mentions, on the authority of Mr. Headrick, a road found under moss on the Estate of Hartfield, near Paisley, which he supposed to be of Roman work. That road had not been shewn to me when I first surveyed the improvements on that Estate, and I returned to see it and these improvements again. A road composed of broad flat stones, has certainly been found under moss three or four feet deep, on that Estate, and made over a bed of peat earth, and it is more likely to have been made by the Romans than by any other people; as their roads were generally carried through such elevated tracts, where the trees were smallest, and the best view obtained of the hostile natives. A road has also been found in Logan moss.

When the great canal between the Forth and Clyde was

cut, there were found at a great depth under moss, in the bog of Dallatur, some Roman altars, which are shown in the Museum of the University of Glasgow; and Dr. Rennie makes mention of a beautiful Roman altar dedicated to the Nymphs, and found under a moss at Nethercraig, in the parish of Cumbernauld, where it may be still seen. Another altar of marble, dedicated to Diana, was found at Ardennis. That well informed author mentions many other Roman antiquities found under moss on the Continent, which I shall not enumerate, as my views are restricted to Britain. The many Roman arms, coins, utensils, &c. mentioned to shew the absurdity of the antediluvian origin of moss, may also show, that many of the forests have been cut down by that people, not overthrown by the deluge *.

The respectable historians referred to, and the Roman roads, coins, and implements which have been mentioned, shew what terrible havoc that people made among the forests of Britain. I am of opinion with the intelligent Dr. Rennie, that the greatest part of all the deep flow-mosses in Britain, under which felled trees are found, may be considered as legacies left us by the Romans; though without doubt other causes operated, and other agents were employed in the overthrow of these beautiful forests.

* Since this Treatise went to the Press, an account appeared in the Newspapers, of some ancient Roman silver medals being found at the bottom of a moss, five feet in thickness, on the Lands of Crosswoodhill, the property of ANDREW STEELL, Esq. W. S. in the parish of West Calder, and County of Edinburgh. They bear the names DOMITIAN, TRAJAN, HADRIAN, PIUS, and one of them bears the name of MARCUS AURELIUS ANTONINUS. They are all in great preservation. The name of the Moss is Collin Shaw, i. e. the Herd's wood; and it abounds with the remains of the trees which composed that wood, among which the coins were found. As there was a Roman camp in the neighbourhood of this Moss, occupied by M. A. ANTONINUS's troops, it is probable that the medals have remained there for 1600 years, and that the overthrow of that wood by the Romans, has led to the formation of the Moss which now covers it five feet deep.

I saw lately at Easter Breigh, near Livingston, an axe, apparently of Roman workmanship, which was found lying by the side of a large oak, that was covered with Moss.

The protection which these forests afforded to the native inhabitants, when hard pressed by an invading foe, rendered them so extremely formidable to their enemies, that it is natural to suppose they would make great efforts to destroy them. Rude people, such as the Celtic tribes were at the time the Romans invaded Britain, might make war on each other in their own way, but they had not attained to that degree of refinement which would enable them to cut down forests. Their excursions were predatory and temporary, like those of people in that stage of society, but they were strangers to the Colonial system. They had rude weapons for the field of battle and for killing animals; but they had none for cutting down the forests.

The Romans must therefore have been the first who waged war against the woods of Britain. But after the native inhabitants had been taught by the Romans to make the axe and the saw, they would make use of them in their future wars. The invasions of the Caledonians were formerly for plunder. They might burn, if that was practicable, but they could not cut down a forest. But when the Romanized Britons took the field, they would imitate the Romans in their mode of warfare.

Accordingly we find, that as far back as authentic history reaches into the gloom of the dark ages, when wars were made not merely for plunder, but for conquest, the woods and forests were cut down to secure these conquests.

The Danes cut down and burnt many woods in the northern parts of this island, the remains of which are frequently dug up, bearing the impression of fire*.

King Robert Bruce, in his expedition against Cummin Earl of Buchan, destroyed some forests near *Inverury*, mentioned

* In the parish of Applecross, trunks of trees are found under ground, on the hills and meadows where no wood now grows. They bear the evident marks of having suffered by fire. Tradition reports that the Danes burnt down the forests there. (Stat. Account, vol. III. p. 379.) The same account is given by the Minister of Edzell in the County of Forfar; (vol. V. p. 103, of the Stat. Account.)

by Fordun, vol. II. page 241st. The trees then cut down are still found under the mosses, which have since risen over them to a great depth *.

Edward the First, to secure his conquests in Wales, ordered the forests in that country to be cut down and burnt. Henry the Second, from the same motives, gave similar orders as to Ireland; and it is likely that the mosses in both these countries proceeded from these origins. John Duke of Lancaster set 24,000 axes to work at one time, to cut down the forests in Scotland.

Many of the forests in Britain were cut in order to extirpate the wolf and other ferocious animals, as appears from Acts of Parliament of Scotland and England. In some parts they might also be cut down for fuel, or for clearing the ground for agriculture; but in these cases the trees would not remain on the ground, and contribute to the formation of moss-earth.

3. *The overthrow of the forests led to the formation of moss-earth.*

But whatever may have been the period at which the forests were cut, the motives which led to, or the people who executed, the work, it is evident that the overthrow of these ancient forests led to the formation of the greatest part of the deep flow-mosses to be met with in Britain. A most unfortunate change indeed! resulting from the manners of the age in which it happened, and that barbarous disposition to war, which has been and still continues to be the scourge of the human race.

As these forests reached to the very summits of the hills and mountains, they must have been useful in sheltering the ground, and highly ornamental. Trees are the clothing which nature has provided for the shelter of the earth, as well as its greatest ornament. Whenever it is divested of that shelter and ornament, it is as much injured and deformed as a fowl that is deprived of its feathers, or a quadruped of its hair.

* Statistical Account, vol. XV. page. 144.

Had a reasonable portion of the ancient forests been preserved, on the high grounds and on suitable spots, they would have beautified the country, mended the climate, and enriched the soil, as well as proved a source of wealth to the proprietors and to the nation. Whereas moss-earth, which now occupies the site of these forests, is, compared with them, of small value, of an unsightly aspect, and injurious to the climate.

The extensive plains and fields covered with felled trees, lying in all directions, with their branches, perhaps their leaves, and with the brush-wood and coarse grasses that grow under the trees, could not fail to create such a stagnation of air and moisture as would soon banish the richer grasses, or succulent herbage, and introduce in their stead the coarse aquatics which grow in such situations. The plants which formerly grew on the soil, if they vegetated for a season or two, would (like every plant which grows under trees, brush-wood, or any incumbrance laid on the soil) spring up through the trees, and by filling up the interstices, increase the stagnation till nothing but aquatics would grow, and increase in depth every year.

This change in the herbage would no doubt be different, according to the stagnation being more or less complete, but in all cases where the growth of the rich grasses was interrupted, and any species of the aquatics introduced, the formation of moss-earth would follow, slower or faster, in proportion to the stagnation of moisture.

4. *The objections to the foregoing theory considered.*

Dr. Anderson, in the treatise already referred to, argues strenuously, that wood forms no constituent part of moss-earth, but is only an accidental admixture with it, like stones or any other thing it may happen to envelop in the course of its formation.

When I first met with the Doctor's Treatise, I considered the arguments he had used as his own, but Dr. Rennie has dis-

covered that Degnier taught the same doctrine many years ago, and that Dr. Anderson has only retailed the opinions of the learned Dutchman in a finer dress. Their arguments are intended to establish two distinct propositions, *first*, That wood is not a necessarily constituent ingredient in the formation of moss-earth; and *second*, De facto, trees are seldom found in that substance. The proofs they advance are somewhat interesting. 1st, The common opinion of the inhabitants of Holland. 2d, Trees are not in every moss. 3d, Trees are often found where no moss is formed. 4th, Where trees most abound there are fewest mosses. 5th, That moss being found thirty or forty feet in depth, it could not be formed of wood; that one acre of moss contains more inflammable matter than twenty acres of the finest forest; and 6th, That if forests are converted into moss, the greatest part of Muscovy, Tartary, America, &c. would have long ago undergone that change.

The first proposition is so far correct. Wood is not a necessary part or ingredient in moss-earth. Many millions of acres both of hill and bent moss, and also of some flow-moss, have certainly been formed without wood, or where the wood contributed but little to their formation. But that wood is a constituent ingredient in the greatest part of flow-mosses, and that in all those where it is found, it is the source from which the moss proceeded, has been established beyond all doubt. But the ingenious Dutchman and his proselyte say, that trees are found where no moss abounds; as in Tartary, America, &c. The reason is obvious, the forests in these countries have not been cut down. The Roman Eagle was never planted in these regions. It is not the growing forests which produce moss-earth, it is only formed over them when they are overthrown, and the trees suffered to remain on the ground.

Dr. Anderson says, that some mosses are thirty or forty feet thick, and quite solid over a vast extent of surface, while the thickest wood could not form a solid body of above two or three feet in thickness over the whole surface of the ground on which it grew. But this is a mere quibble; for no man ever imagined that the whole strata of moss-earth was entirely

composed of wood. None but he and Degnier ever said so, and for the purpose of giving a false impression to the argument. All that has ever been said was, that the felled trees created such a stagnation of moisture, as to banish the rich grasses, and the aquatics having risen in their room, they did not dissolve and decay as the richer grasses had done, but remained and accumulated under a partial decay, till they have risen over the wood to the depth of forty or fifty feet in some places. But though the overthrow of the trees introduced the moss plants, and these have formed the moss-earth, no man in his senses would ever pretend that the whole moss was composed of wood; a notion truly *sui generis*; and one of the men of straw which these Gentlemen have set up, to shew their dexterity in overthrowing them.

Neither did any but themselves imagine that all the inflammability found in the deep strata of moss, was communicated to it by the few trees found in the bottom. That is a notion of their own, and not of the Philosophers against whose opinions they have waged war. Moss originating from a lake, or any other cause, is, in similar circumstances, as inflammable, as that rising over wood. The Inflammability, Tannin, Extract, &c. do not proceed from the wood, but from the plants of which the moss is formed. Inflammability of the moss earth increases as its putrefaction and decomposition advance. There is more Tannin in Tormentilla, for instance, a plant found on every moss, than in the best of oak bark. These are the qualities of the moss which proceed from the plants of which it is formed, not of the wood which first introduced these plants, and gave rise to some of the deep mosses.

But these Gentlemen also argue that wood is seldom found in moss, or that, when it is enveloped in it, it is by mere accident, like stones or any other substance. "Trees are found sometimes in moss," says Dr. Anderson, "and it is equally true that flies are found in amber: but does it from hence follow, that the amber is produced from dead flies?" He avers, that he has seen many thousands of cart-loads of moss removed to the clay, without the least vestige of wood being

found, and that only a tree or two was found in each acre of Kincardine moss, when dug up and floated off by water. He thinks there can be none under Moss Cree, or under mosses in the Island of Lewis.

As Dr. Anderson does not mention where the mosses he has seen removed are situated, I can say nothing about them. But as to the wood found under Kincardine moss he has been much mistaken. The intelligent Dr. Robertson, in his survey of Perthshire, says, "the surface of the clay below that moss is every where thickly covered with trees, chiefly oaks, and birch, many of them of great size. They are found lying in all directions, beside their roots firm in the ground, in their natural position, and from impressions still visible, it is evident that they have been cut with an axe or some similar instrument. When the moss is removed the clay is found to be encumbered with the roots of different kinds of trees, standing as they grew, often very large; their trunks are also found lying beside them," (page 494th). Dr. Robertson says the same of Moss Flanders.

To authority so respectable, it is scarcely necessary to add, that Dr. Anderson's assertion as to Kincardine moss, induced me to survey it anew, in April, 1804. I have passed over it three times since that period, and can attest that several hundreds of trees are generally found in each acre of that moss, with their roots in the subsoil, as Dr. Robertson mentions. I have also traversed many of the mosses on both sides of the Forth, from the head to the mouth of that River, and found all of them to abound with trees under the moss, having their roots firm in the subsoil. The Minister of Kippen corroborates, in the Statistical Report of his parish, the accounts here given of these mosses.

Dr. Anderson seems, by his reference to the mosses in that county, to have resided in Aberdeenshire, when he composed his Treatise on Moss. If he had examined these mosses with attention, he would have found they abounded with fossil wood, and that the roots of the trees were in the subsoil. For proof of this, I might refer him to the Statistical Account of the pa-

ishes of Pitsligo, Inch, Langside, Kintore, Peterhead, &c. &c. where the writers of these accounts mention the trees and roots of trees, under the mosses, in the same way as Dr. Robertson describes those of Kincardine moss.

Dr. Anderson himself mentions a moss in that County, much encumbered with roots or stumps of large oak trees, standing as they grew, some of them eight feet in diameter, and in many places so close together as not to be more than three or four diameters distant from each other, and he adds, "*Many instances of the same kind I could condescend upon.*" So that he was no stranger to trees being found under moss, with their roots in the ground where they grew.

He is not more correct as to what he states concerning the moss of Cree. Mr. Heron in his Tour, vol. II. p. 248, mentions, that wherever the moss of Cree is cut up, large trunks of trees are found *laid extremely thick*, and most of them undecayed. The trees are Oaks and Pines*. Dr. Walker says, "Locher moss in Dumfries-shire, the moss of Cree in Galloway, and Moss Flanders, in Perthshire, are all situated near the level of the sea, and in the best climate in Scotland for the growth of a tree; accordingly in these we find trunks of large size" (page 14th). In page 7th he says, "Though Lewis is now entirely destitute of timber, there are large trunks of Alder, Birch, and especially Scots Fir, found in its extensive mosses."

Dr. Barry gives the same account as to the Orkneys, and the Rev. Dr. Rennie says, "Trees are found in most of the mosses in Europe. In nine-tenths of the British mosses they abound." If any testimony from me were necessary, after the cloud of witnesses adduced, I can well attest, that I

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* It is stated by Dr. Walker, that no Pines have been found under moss on the south side of the Forth. But he has not been sufficiently informed on that subject. I have seen Pine trees, and roots of Pines in every County, from the borders of North Wales to the Forth; except in East and Mid-Lothian, Roxburghshire, Selkirk and Berwick, which I have not examined on that head; but in which I have no doubt they may also be found.

have examined many mosses in every County of Scotland, and in several of the English Counties, and never saw a flow-moss, of any considerable extent or depth, but I found in some part of it, trees more or less, with roots generally fast in the subsoil, in the very position in which they grew.

Degnier and Dr. Anderson are the only authors I know who have attempted to deny that fact, and their ambition to overturn the generally received opinions of Philosophers, seems to have hurried them into that error. But in whatever manner these Gentlemen may think proper to treat *opinions*, they ought always to pay a sacred regard to *facts*; as it is much better to form opinions from well authenticated facts, than to pervert facts to the support of fanciful opinions.

SECT. VII.

Of the formation of Moss in Lakes and Stanks of water.

1st. Lakes are filled up and converted into Mosses, by plants growing from the bottom.

THE origin of our deepest flow-mosses, in low situations, may easily be traced to lochs, lakes or pools of water. When a loch or lake is of great extent, of considerable depth, and its bottom composed of rock or gravel, it is likely to continue a lake for ever. As in these cases the plants which grow in lakes have no soil suited to their natures, into which they can strike root, and from which they can spring up; the waters are too deep for plants to grow in, and the agitation by the winds in winter is such as would dash them to pieces if they did vegetate in such situations.

But if the surface of the loch or lake be narrow, the water of a moderate depth, and the bottom covered with clay, small sand, mud, or any other soft substance, an immense number of aquatic plants strike root in the bottom, and send up their

stems into the open air, above the surface of the waters, where they attain perfection, and ripen their seeds from year to year. The bountiful Creator does not limit that most useful and beautiful part of his works, vegetation, to any particular soil or situation, but extends it over every part of the earth's surface. The dry land, the moist place, and the marshes are carpeted over with plants suited to the diversities of such places. Even for the lakes and pools of water, nature has provided vegetables to beautify and enrich them.

The plants which grow in, and under water are numerous, and much diversified in size, shape, and qualities. The greatest part of those which grow in the deepest waters, are of considerable bulk: they must all strike root in the mud, or other earthy substance at the bottom, and they rise up many feet from their roots to the surface, and some of them to a considerable height above the surface of the water. Like other vegetables, they attain their full size and perfection, after which they die and sink under water; and putrefaction begins, where vegetation ends. But on them its progress is slow, in comparison with what it makes on the herbage which grows on dry land; as all aquatic plants abound in acids, or other qualities which retard putrefaction, and being buried under water, the air, so necessary to accelerate its progress, is too scanty for a rapid dissolution. They remain under water for many ages but little diminished in size, and their frame but little impaired; they do not even dissolve so fast as the moss plants, which have grown and accumulated above the level of the waters.

A new crop of them springs up every year, which in their turn arrive at maturity, die, fall below the water, and add their mite to the stratum of vegetable matter at the bottom of the lake, till in the course of ages, the successive crops of these bulky lake-plants, roots and stems, netted and heaped together, under a very partial decay, form a stratum of lake-turf, which sooner or later rises to the surface of the water, and ultimately annihilates the lake, or at least the shallow parts of it, and converts it into a marsh of lake-turf.

The first vegetable settlers in the loch, and those which advance farthest into the deep waters, are the following, viz :

- Pondweed . . . *Potamogeton natans.*
- Water Lilies . . . *Nymphaea Lutea et Alba.*
- Bull rush . . . *Scirpus Lacustris.*
- Reed Grass . . . *Arundo phragmitis.*

When these have grown some time, and raised up the bottom of the lake, the water *Plantago* (*alisma plantago*), the marsh parsnip, (*sium angustifolium*) *comarum palustre*, *pediculus palustris*, *equisetum fluviatile*, some of the sedges (*carices*) and others introduce themselves; and when these have raised the mossy turf to the level of the water, the Cotton heads (*eriophora*) marsh fogs, and whole tribes of plants, which grow on wet flow-mosses, start up, add to the depth of the mossy stratum, and raise it to a great height above what once formed the surface of the lake.

In this way have many lochs, lakes, and pools of water, of moderate depth, and where the bottom was of earth or mud, gradually grown up, with lake turf, till it rose to the surface of the water; and the flow-moss has afterwards risen over that turf to a great height; and is still increasing in depth, in proportion to the humidity of the surface: probably some part of every deep level flow-moss, may owe its origin to the process of nature which I have been here endeavouring to describe. That must have been the case wherever a shallow pool or stank of water stood, sufficient to prevent the growth of trees; and no doubt, there were many such places, in all level spots, where flow-mosses are now found.

In cutting up the moss to the subsoil, it is easy to distinguish, that which has been formed under water, from that which has grown on dry ground. Wherever trees, or the roots of trees in the subsoil, are found under the moss, it must be evident, that no lake could have been there, as trees do not grow in lakes; but where no trees or roots of trees are found, and where the under-stratum of the moss is composed of a tough matting of strong and coarse aquatics, or lake plants, nearly as bulky as when they grew, they afford a

positive proof, that that particular spot, was at one time a lake, and that it was filled up in the manner I have mentioned. Such turf is entirely different from ordinary moss, and is named *Davy* in Ireland.

Those shallow lakes grown up in that manner, would form the small patches of moss found in the country before the forests were overthrown; there could be no other deep moss, for every part of the soil was covered with trees, that was not too damp for their growth. The moss of Foolsworth near Manchester, was certainly begun to be formed in some places, before the Romans cut down the forests, from which the greatest part of the mosses in its neighbourhood originated; for in digging up the road made by them through that forest, from *Muncunium* to *Cambodunum*, several feet of moss were found at one place under that road: this probably had been a small lake, on which wood could not grow, and which had grown up and become a moss, long before the forest was cut down, or any other part of the moss begun to be formed. Many such instances might be found on inquiry.

The whole of the process of nature, in converting lakes, lochs, and stanks of water, into turf bogs, and from turf bogs into flow-mosses, has been going forward ever since plants began to vegetate; and it may still be seen going on in all parts of Britain. It requires no great degree of penetration or sagacity to trace it out, as it is plain and obvious to every one who turns his attention to the subject: it may be seen at every loch, lake, or ditch, where the water is but a few feet in depth, and where the bottom is composed of mud, or soft earth. Any person who surveys a loch, will easily perceive the numerous tribes of bulky aquatics, growing in all the shallow parts of the lake, where the bottom is propitious to the growth of plants; and gradually advancing forward to the deeper parts of the lake. If the survey is made in summer or harvest, when the plants are in their greatest luxuriance, the shallow parts of the lake will appear like a meadow, and the water only visible in the places too deep for plants to strike root, or where the bottom is bare rock or gravel. But

if it is viewed in winter or spring, the whole is a lake, and nothing is seen but water.

I have, since the Highland Society called on me to prepare a second edition, surveyed many lakes and lochs in all parts of Scotland, and also those in Cumberland and Westmoreland; And I prevailed on Mr. James Smith, Gardener at Monkwood in Airshire, to accompany me to many different lakes, for the purpose of assisting me in examining their Botanic productions. Most of the lakes in the west of England are large, and deep, their bottoms being rock, stones, or water gravel, where no plants can strike root, and where the agitation of the water would dash them to pieces. Loch Lomond, Loch Awe, Loch Tay, Loch Earn, Loch Ness, Loch Leven, Loch Doon, Loch Ken, and hundreds more which I have surveyed, in all parts of Scotland from Caithness to Galloway, are, generally speaking, destitute of the plants which grow in the smaller lakes and ultimately fill them up. But even in most of these, I have found, in sheltered corners, where the waters were shallow, and the bottom composed of soft earth, the water plants growing, and some lake turf formed. The same thing is to be found in some corner of every one of the smaller lakes or lochs in all parts of Great Britain; and many hundreds of such lochs or stanks have been already converted into mosses or meadows by these means.

When I approached a lake, stank, or pond among arable land, I have uniformly found a zone of meadow ground, next to the arable, and of greater or smaller breadth, according to the slow or sudden rise of the ground. Next the arable ground the meadow is firm and nearly arable, producing the best of meadow grasses; but as you advance nearer the lake, the meadow becomes softer, wetter, and the herbage coarser, and more bulky: as I advanced, I sunk deeper, and found nothing but *Carices Paniculata*, *Stricta*, *Ampulacia*, *Cespitosa*, *Hirsuta*, and others of that tribe; the *Eriophora Vaginata*, *Nardus Strictus*, with a variety of the *Hypnum*, *Scirpus Cespitosus*, and many smaller plants. On the very brink of the lake I met with the *Juncus Palustris*, *Arundo Phragmytis*, *Scir-*

pus Lacustris, &c. Beyond these are seen the Nymphaeæ Lutea et Alba, and last of all the Potamogetan Natans: but by the time I got among the Carices, I had generally sunk above the ankle in water; and when I ventured to tread on the Scirpi Lacustres, &c. I was above the knee; when I got among the inner ranks, or stood long on one place, attempting to take up some of the Nymphaeæ and Potamogetan, in order to ascertain their dimensions, I have sunk to the groin in the water. I have taken up the *Petiolus* or foot stalk of the leaf of the Nymphaea, about the thickness of my finger, and nearly six feet in length. And I have found parts of the trunk of this plant as thick as my leg, and ten feet in length, but never could discover its dimensions when entire. I am certain of having seen its leaves and flowers on the surface, when the water was more than eight feet in depth; and the Potamogetan grows in the water still deeper than the Nymphaea.

When I sunk so deep in water, my feet did not go through any part of the herbage. Even that which was above the surface went down for several feet round me by my weight; but rose again above the water's surface, when I left the place. The roots or stems of the former crops of these plants, are so loose and distant from each other, that they yield to pressure. When I went upon them, they resembled so many fisher's nets, or webs of cloth, in a cask or pool of water.

When the lake or pond is surrounded with moss, the only difference is that no meadow ground is found on its verges. The heather and other plants which grow upon flow-moss, continue till near the verge of the lake. When one comes within a few yards of the water, the Eriophora and Carices that have been named, Juncus Palustris, Arundo Phragmytis, Scirpus Lacustris, appear high above the water, and the Nymphaeæ and Potamogetan, still farther in, have their leaves flat on its surface. To satisfy myself still further on this subject, I have dug through the flow-moss and meadow ground, in places where I supposed lakes had formerly existed, and on the verges of lakes which still exist, and have always found the lake turf under the meadow or flow-moss. It is easily distinguished

from ordinary moss; as the roots of all the plants which compose it are thick and bulky, and are found not only visible, but almost entire, and so tenacious, that they are not easily cut with a spade. The roots of the marsh Trefoil (*Menyanthus Trifolatus*), is found like spun tobacco, or thongs of whips. Moss or turf of this kind is not nearly so inflammable as that formed above water.

2d. *Plants do not grow, nor is Moss-earth formed, over the surface of Lakes.*

Before I quit this part of the subject, I beg leave to notice an opinion advanced by Mr. Nasmith, in which he is followed by Dr. Rennie, viz. that moss-earth is often formed to a great depth *over the surface of Lochs*. Mr. Nasmith says, "Neither
" is fallen timber a necessary, though a frequent agent in the
" formation of peat. Many beds, of great extent and depth,
" are superincumbent over a body of water. When cutting
" ditches in some of these many years ago, I found, on topping
" the bottom of the ditches, from four to five feet of water,
" under a body of peat ten or twelve feet deep. The water
" sprang up clear and untinged with peat, bringing along
" with it fragments of grass leaves, accompanied with the
" spoils of the Coleopterae (water clocks), which inhabit pools
" of water. So many instances of the same kind have oc-
" curred in different places, that any attempt to prove that
" peat has so usurped the place of many ancient lakes, would
" be superfluous."

Dr. Rennie seems to adopt the same theory as to the origin of some part of our mosses, and quotes *Degnier's* description of some mosses in the neighbourhood of *Utrecht*, where "after
" digging a foot and a half deep in the surface, they come
" immediately to the subterraneous water, and when the
" moss is entirely dug out, all that remains is an extended
" lake. That in twenty or thirty years, sixty, eighty, or one
" hundred acres are sometimes cleared of moss in this way;

“ the waters become sweet, and fit for every domestic purpose ; fishes of the best quality abound in these lakes.”—He then goes on to state, that these lakes are sometimes laid dry, by wind mills, and the soil cultivated, and adds, “ so that these mosses may be seen undergoing the following changes : they first appear as a rich meadow ; then turf is dug under this ; a rich supply of wood is often found under the turf : when these are all removed, the whole appears an extended lake abounding in fishes ; and at last, when this water is drained off, it is converted into a rich and fertile soil.”—So far Degnier.

Dr. Rennie adds, “ Some mosses in this neighbourhood (near Kilsyth) exhibit the same proofs that, at one period, they were lakes. After digging four, six, or ten feet deep, the subterraneous water is laid open ; this often rushes up with such rapidity, that the pit is filled to the surface, before the person who dug it, can escape out of it.”—(page 158).

These Authors also explain the way in which nature proceeds to envelop the lakes with moss earth. Mr. Nasmith says, “ The plants of which peat-earth is formed, propagate and extend in a horizontal as well as in an upright direction. When they had formed a body along the margin of the lake, they would gradually stretch their trailing branches over the surface of the water, till they at length met in the centre, and the covering would from year to year augment in thickness.”

Dr. Rennie quotes a letter he had received from M. De Luc, to show that nature does not wait the regular approach which Mr. Nasmith supposes, but occupies at once, the whole surface of the lake, by a *coup de main*. The *conferva*, he says, covers with its green clouds, the surface of the pool in one summer. The *Sphagna* follow next year, and thicken the bed which the *Conferva* had begun, and the growth is so rapid, that in the course of thirty years, good peat may be cut from a pit that had been dug seven feet deep, and filled with water.

"The first year they are filled with a mucous substance
 "that swims on the water like a green cloud; the second
 "year this substance is composed of fine threads, and gar-
 "nished with very small leaves, and flowers and seeds, so that
 "the water is filled with these nearly *two feet deep*; the third
 "year this is covered with (*Mousse a longs panaches*) Moss
 "with creeping roots and leaves and branches; these cover
 "the water entirely, arrest the dust, and all the seeds which
 "float in the air. Thus it becomes a fit soil for aquatic plants,
 "rushes, reeds, grasses, &c. which grow with great luxuriance;
 "the fourth year these plants are so thick set, that they
 "change the surface on which they grew, and sink with it
 "in the water, &c." In an explanatory letter, he declares
 the green cloudy mats to be *conferva*, a vegetable the fruc-
 tification of which had been discovered by microscopic ob-
 servation by one of his countrymen; and Dr. Rennie says,
 the growth of the second year is probably a collection of those
 aquatics, whose roots and leaves are of a Capillary form, such
 as the *Byssus* or *Chara*, vulgarly called Horsetail, *Equisetum*, &c.
 the small leaves, and flowers, and seeds, he thinks are the
Lemna or Duckmeat, which he found in the mosses in his
 neighbourhood *.

With all deference to these very respectable gentlemen, and
 the authorities which one of them quotes, I cannot become a
 proselyte to their opinions.

My incredulity is founded on two grounds: First, I cannot
 perceive it to be consistent with any of the laws of nature, that
 I am acquainted with, for vegetables to establish themselves

* The *Equiseta* are a family of plants, which grow on damp grounds,
 commonly called *Puddock Pipes* by the country people. That which is denomi-
 nated *Horse tail* (*Equisetum Arvense*) grows on corn fields, at the sides of
 dikes, in a moist soil; but is never found in lakes. The *Equisetum fluviatile*
 grows on the verge of lakes, but generally rises a yard and a half above the
 surface of the water, and I have traced its roots as far below: these can never
 be the plants which grow over the surface of the water, as having nothing for
 a soil but *Conserva*.

over the surface of lakes : And *second*, I have never been able, after much inquiry, to discover any mosses so formed.

The formation of moss-earth, or of the plants from which it is formed over the surface of waters, does not appear to me to be at all consistent with the laws of vegetation. Vegetables are terrestrial, not aquatic productions ; they cannot exist but in connexion with the earth. Some aquatic plants will live, and even grow for a time, in water, but I know of none which grow from seeds thrown into the water, unless they maintain a connexion with the earth. I know many plants which vegetate under water, but it is always in connexion with a soil of earth at the bottom ; but I know of none which grow on the surface of water, except the Lemnas, which are so small and feeble, that they cannot withstand the slightest agitation of the waters by wind or otherwise ; and I do not believe that the growth of that tribe, were it not to be injured by the wind for a century, would form a soil into which any other plant could strike root. If any other plants grow in water alone, they are too small and insignificant for the formation of moss-earth, or even of becoming a matrix for the plants which contribute to the formation of that substance.

But Mr. Nasmith seems to have been aware of the objections here offered, and has contrived a race of moss plants which propagate in a horizontal as well as in an upright direction, and stretch their trailing branches from the sides to the centre of the lakes. I wish he had named the plants to which he refers. They must be such as I have never seen, and know nothing of. He names many plants which grow upon, and contribute to the formation of moss-earth, but none of those which he names propagate horizontally, nor did ever any one of them extend its branches six yards over a lake.

He mentions the *Lycopodium* : if he mean the *Lycopodium Clavatum*, it is certainly a plant which extends horizontally, but it does not grow in water or even in moss, or damp ground ; it is only found in dry wild ground. The *Lycopodium Celognudum* grows in flow-moss ; but is rather a scarce plant, very small, and sends out no trailing branches. There

are many plants that propagate horizontally in dry ground, but all of them as they advance, strike roots into the earth, at a very few inches distance. The *Poa Aquatica* floats on the water, but is never seen in moss water, nor in deep water any where, and it also sends down roots to the bottom as it advances or creeps along. The *Festuca Fluitans* grows in moss ditches where water from richer ground passes, but it never reaches a yard from its root.

Supposing, however, that all the moss plants Mr. Nasmith has named, were to grow and extend horizontally from the verge of a lake, none of them could ever reach the centre. The reed grass and bull-rush grow to a greater length than any he has named, but what person ever saw them growing horizontally? or if they did, who could expect that they would extend from the verge to the centre of a loch "of great extent?"

But if these, or any other plants whatever, (except a tree) were to grow on the surface of lochs, the waves in winter would dash them to pieces, or wash them on shore: for these reasons, I consider the Theories of Dr. Rennie and his Correspondent, and also that proposed by Mr. Nasmith, to be contrary to the laws of vegetation.

My second ground of scepticism is to me equally insurmountable. If ever lakes had been, in Britain, covered with plants growing on the surface of the waters, and others rising more bulky over them, the same process of nature would be still going forward somewhere, as long as any lakes remained uncovered. Now, though I have surveyed almost the half of the lakes in Britain, I have never met with any such process going forward any where; if nature covered any loch in that way, how did any other loch or lake escape the same fate?

I have also been diligent in my inquiries, but have never been able to discover the lake-suspended-moss which they mention.

I expected to have found it in Mr. Nasmith's own lands of Drumloch, where he discovered four feet and a half of water under a deep bed of moss-earth, and I went there to inquire.

His tenant, who is very intelligent, and enters much into the notions of his Laird on that subject, assured me it was in a moss which he possesses, where that subterraneous lake was found, and where it still lay, and pointed out the spot where he said I might tap the water, at three or four feet from the surface. Not having at that time apparatus for the experiment, I returned sometime afterwards, with a pole ten feet long, which I repeatedly sunk in the moss at the place he had pointed out, without finding any water.

If such water was there "a great many years ago," it must either be there still, or if it has made its escape, the moss must have sunk four feet and a half: there is no such depression in any part of the surface of the moss, and therefore, as the tenant avers, the imprisoned lake must still remain under the moss. Moss is lighter than water, but when a body of that earth is heaped over the surface of a lake, the pressure must be very great; a square yard of moss newly dug, weighs about a ton weight, of course the weight of every acre of moss twelve feet deep, must be upwards of twenty thousand tons in weight; when the super-incumbent moss is solid, the water cannot escape, but when it is covered with a flow-moss as soft as curd, into which a man would sink were it not for the matting of herbage on the surface, I am persuaded, that the water, from the extreme superincumbent weight, would force its way through the incohesive moss-earth, and escape from its prison. I am confident, that, when once a hole was pierced through the superincumbent moss, the imprisoned water would, under such a pressure, rise above the surface of the earth, and continue to flow till the whole escaped. The weight of twelve feet of moss over the surface of a lake, would operate with much greater force, than the strongest powers of any fire engine.

I had often been told, that certain mosses were suspended over lakes, and long concurred in the common opinion, without inquiry: but a doubt rose in my mind on that subject, and for many years past, I have made particular inquiry into the fact; and these researches have not tended to dispel my doubts.

It was to ascertain that fact that I first attempted to gauge Moss Mulloch in the Parish of Avendale, Lanarkshire, about six years ago. Mr. Dykes, Fieldhead, mentioned the common opinion, that a lake was imprisoned under that flow-moss; the result of my investigation, in which he assisted, confirmed my doubts, and convinced him that there was no lake under that moss. I had been told from my infancy, that a moss in the neighbourhood of Lockgate, also in that parish, floated on the surface of water, and that the people in the neighbourhood, when they laid their flax in steep, had no more to do than to cut a hole, sufficient to let in a sheaf of flax, and that they could sink as much lint as they pleased in that hole, as the water below was of great depth. My father and grandfather, who had been brought up in the neighbourhood, assured me, that this moss floated on water; and that opinion prevailed and still prevails in that part of the country where it is situated. To ascertain the fact, I went with Mr. Young, junior of Peelhill, and Mr. Taylor, both of whom had heard the common opinion on that subject; they conducted me to lint holes, in which I found nothing interesting; they have been cut ten or twelve feet square, in a soft flow-moss; and the moss earth dug from them remains in the form of a ridge round the mouth of the holes, which I found very soft in the bottom, and the pole I had did not reach the subsoil; but so far from finding a lake under the moss, I found in two or three of those lint pits, stones which had been laid over the lint, suspended only four feet below the surface of the water. The supposed lake in this case, as in all others I have ever investigated, turns out a mere vulgar prejudice, which, though like the antediluvian origin of moss, it can be traced to no authority, and is void of probability, and even contrary to the laws of nature, has been handed down from father to son, and implicitly credited without due inquiry. Had this moss floated on water, would not the weight of so large a body pressing its surface, have raised the water at the hole which had been cut?

I am no stranger to the quag-mires or hobbling quags, to be

found both in mosses and arable ground; they are composed of a thin matting of herbaceous matter closely netted together, forming a sward sufficient to support the weight of a man, and extended over a small space of ground, where a quantity of moss or mud, in more than a semi-liquid state, is confined. The interior of these quags is so soft, as to yield to a very slight pressure. They frequently resemble a cloth, or hide of leather, suspended on the surface of a pool of water.

But these are not the lakes "of great extent," to which our authors refer. I have seldom met with any of them to the extent of two fells of ground; they are not in low situations where a lake could ever have existed, but generally on reclining plains, or on the face of rising grounds. In all cases they proceed from the same cause; a small spring of water oozing from below, and the sides composed of moss or other earth, which detains the water, and forms it, with part of the moss or mud, into a mire; over which a matting of herbaceous matter is formed, which converts it into a hobbling quag, or quagmire, and these are not peculiar to mosses, but are found also in clay grounds, where small springs start up.

Something similar is frequently met with in peat-pots, lint-holes, or ditches cut in moss or any other soil: when these are of small dimensions, they often become dry during summer, when the rushes, sprits, and bulky herbage take root, and continue to grow even when the hole is filled with water. They grow so loose and open, that they cannot support for many years the weight of a man, and even when they have acquired more solidity, they yield to his foot, and form a sort of hobbling quag: all these (if no spring rises from below) are ultimately formed into solid moss; but none of them from plants that swim over the surface of the water, or extend their trailing branches horizontally from the verge to the centre of the hole; but from those that strike root in the bottom, raise their stems above the water, and thicken from year to year till they fill up the pit. For many years after vegetation begins in these stanks, it grows loosely among the water, but when the hole is filled up, no imprisoned water remains. The

whole is equally solid from top to bottom, and may in course of time be cut into peat.

There may, however, be instances of some water being pent up for a time, in a deep bed of flow-moss; a spring may be shut up in its ordinary course, and finding vent under moss, may collect in or under it, and ultimately burst forth, and carry some of the moss along with it. A stream of water may, when running over moss, penetrate some fissure in the strata, distend it, and form an imprisoned pool of small dimensions. Flow-moss is always soft, and being much distended by being overcharged with moisture, is very incohesive; when a new channel is opened by nature or art, to relieve some corner of the flow of part of its moisture, perhaps a course of dry weather follows, and renders it very dry to a considerable depth; in that case, it not only sinks on the surface, but many rents or fissures are formed to a great depth: even where it had not been rendered so dry, the greater weight of the wet semi-liquid moss, will form a pressure towards that which was dry, and thereby create rents and fissures every where, which, when sudden rains follow, will be filled with water; the dry moss on the surface being again soaked in moisture, will swell, close the fissures, and shut up part of the water below; some of these rents, and the water they contain, may find their way to each other, and the water may increase in some places in greater quantities than a careless observer would suppose. Small burns and streams of water, are frequently found running for a considerable way under ground in deep mosses; and when one of these covered ways happens to be shut up at the lower end, an imprisoned pool of water is formed.

I shall not pretend to fix the extent of such operations of nature, or say how much water may, in one or other of these ways, or in some way similar, get into, or under some part of a soft open flow-moss. I have often seen, when peats were dug, that small fissures were found, and when pierced, that they emitted a run of water sometimes greater and sometimes smaller. Indeed I never saw deep flow-moss cut to any great

depth, but some of these rents were met with, and the water ran copiously from them for a time: all peat casters are well acquainted with these fissures or *losses*, as they term them, from their breaking the size of the peat. The outlet of any body of water at any place, will leave a void where it lodged: the weight of the moss on both sides, and its want of firmness, would fill up the empty space, but it would at the same time cause more fissures on the surface, where water would again lodge.

It must have been in some such way, that a body of water got under Solway Moss, sufficient to carry off a part of it during a flood in 1771; and the same thing happened in the county of Lancashire, on the first day of January, 1633*.

I will not pretend to say in what manner the water had been collected under Mr. Nasmith's moss, to the depth of four feet and a half; but I cannot believe it was of very great extent: if it were, the water must either have been let out, or would have remained; if it had been removed, the moss would have sunk four feet and a half, which it has not done, and if the water remained it would still be found; a rent or fissure in the moss might contain four feet and a half of water; many such

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* Whitaker, Vol. I. p. 351. talks of imprisoned water in Moss distending the coast, breaking the texture of the moss, deluging the contiguous country with an inky torrent, and overspreading the cultivated fields with a destructive slime.—“Thus, our own Slough's moss burst on New-year's-day 1633, spread a deep bed of filth over the neighbouring lands, and poisoned all the fish in the neighbouring rivulets.”—In proof of these remarks he quotes Camden, p. 611, and Leland, vol. vii. p. 41. who says, “In the very top of Chawmoure (called before Chatley more) where the mosse was the hyghest and brake, is now a fayre playn valley as was in tymes past, and a rille renneth in it, and peces of small trees be found in the botome of it. Chatley more, six myles in lengthe, some way braist within a myle of Morley hawl, and destroyed moche ground with mosse therabout, and destroyed moche fresh water thereabout, first corrupting with stinking water Glasbroke, and so Glasbroke carried stinking water, and Mersey corruptyd, carried rouillyng mosse, part to the shores of Wales, part to the Isle of Man, and some into Ireland.” Whitaker goes on to state, that “upon any long continuance of rain, at present, the crust of Chattermoss is visibly lifted up by the heaving waters below, and even rises so considerably, as entirely to intercept some extended prospects across it.”—See Dr. Rennie on this subject.

are found in flow-mosses, especially in one like his, that is deep, much opened at one side by cutting peats, and having a small burn or rill running through or over it.

I am no way surprised at the remains of water clocks being found in the water; the fragments of Grass-leaves and Equisetum might also be conveyed thither by the water, but how that water could appear clear and untinged with peat, is what I cannot account for, as I never saw water spring from among moss without being tinged with that substance.

SECT. VIII.

Flow-moss proceeding from other causes.

THE overthrown forests seem to have been the chief agents in the formation of flow-moss; some parts of them may be traced to lochs and pools of water, and in some instances they may have proceeded from causes remote from both the one and the other.

Whatever may have detained a large quantity of moisture on the surface of any piece of ground in a climate so cold as that of Britain, must infallibly have led to the formation of moss. In level places, the waters are easily stagnated to such a degree as to banish the rich grasses, and introduce the moss plants; and a greater stagnation is all that is necessary to convert a piece of hill or bent into flow-moss.

I shall not spend time in mentioning all the agents, that may have operated such changes, or in pointing out particular places where they have been effected, but rest contented with merely stating the fact, that all the kinds of moss have been formed without the aid of trees or lakes; and that they may still be formed by whatever detains the quantity of moisture necessary to banish the rich grasses, and introduce the moss plants.

Whatever may have been the means by which the moss was introduced, flow moss is uniformly the same thing under the same degree of humidity: a soft spongy earth, scarcely capable of supporting the foot of man, or browsing animals, of an un-

sightly aspect, abounding with alternate hillocks or hags, tufts of heather, and coarse herbage of no use

The difference in the herbage only proceeds from the degree of moisture detained on the surface; when very wet, the *Sphagnum Palustre*, and *Bryum Hypnoides*, are the plants which chiefly prevail; the former in hollow wet places, and the latter on hillocks; some heather, chiefly the *Erica Vulgaris*, with its usual attendants the *Hypna*, *Filicinum*, *Rutabulum* et *Cuspidatum*, et *Lichen Rangiferanus*; the *Polytrichum Commune* appears on some places, but not so prevalent as on moss beginning to pass from bent to flow: the *Polytricha*, *Angustifolium* et *Vaginatum*, and *Eriophora*, form a part of the herbage. The *Nardus Stricti*, *Scirpus Cespitosus*, *Anthericum Ossifragum*, *Lycopodium Celognoides*, *Tormentilla*, &c. &c.

Having distinguished the different kinds of moss, pointed out the aspect which each presents to the eye, explained the causes from which they severally proceed, and named the plants prevalent on each, I shall close the first Part with some remarks on the depth of the moss strata, and an inquiry into the period of its formation.

SECT. IX.

Of the diversity of depth in the Moss Strata, and the causes from which it proceeds.

VERY considerable diversity has been found in the depth of the moss strata. Hill moss can scarcely be said to have any depth, as in many places, it is not, for acres together, more than a few inches in thickness. Bent moss seldom exceeds three feet in depth, but Flow-moss is found of every depth, from two or three to forty feet and upwards: the causes from which this diversity proceeds, fall to be inquired into.

Some have imagined that such diversity in the depth of beds of moss, proceeds from the distance of the period at which

that substance began to be formed; and others impute that diversity to a greater luxuriance of vegetation, proceeding from the mildness of the climate: both these opinions will be shewn to be erroneous.

Dr. Anderson enters into calculations to shew, that it would require *nine hundred thousand years* to form, from decayed vegetables, a moss twenty feet deep. But the fact is, that no solid data can be found from which its growth or accumulation can be calculated, nor will its depth and age be found to have much connection: all the Hill moss, where no trees have ever grown, has been accumulating since the commencement of vegetation, and yet in many places has not attained to the depth of six inches, while mosses in their neighbourhood have risen to the height of twenty feet, and some to that of forty or fifty feet, since the Roman invasion. It is well known, that all the ground now covered with moss near Manchester and through Lancashire, was covered with growing trees at the time the Romans invaded Britain, and the moss now covers the original soil, and the trees which grew on it, to the depth of twenty feet, and in many places of forty feet. Trafford Moss was found, in some places, to be from ten to twenty feet deep, while in others it was only three. The depth of Chatt Moss has not been ascertained; but has been seen to be upwards of twenty feet deep in some places, and I am confident, that it is upwards of twice that depth towards the centre. Mr. Tart sunk roads into the moss at Castlehead, forty-two feet, and did not reach the subsoil. Halsal Moss in Lancashire was gauged by Colonel Mordaunt, and found to be more than fifty feet deep. All the ground on the River Forth, now buried under moss, was covered with forests, till these were laid prostrate by the Romans; these mosses are known to be thirty feet deep in some places, and probably in others still deeper. The mosses in the vicinity of the Roman wall, from the Clyde to the Forth, have been formed from the forests cut down by the Romans; some of these are known to be as deep as the mosses in Lancashire, already mentioned, in some places, and in others only two or three feet deep. Dul-

latur bog has been found to be fifty feet in depth. From a road formed by the Romans through the parish of Avendale from east to west *, the great number of Roman coins, a sandal, battle axe, horse's shoe, and vessels of brass, which have all been mentioned, being found near that road, it is probable, that the trees from which the mosses near it are formed, were cut down by the Romans; they are of various depth according as they have been kept dry or moist. But that of Moss Mulloch was gauged by me to the depth of forty feet, without the bottom being found: many other parts of this and other mosses in that parish, of the same age, are not three feet deep.

If we consider, that in many places the moss plants have been growing, and the moss-earth accumulating, without interruption, since the commencement of vegetation, yet that earth is not more than a few inches in depth; that in other places, where its origin can be traced to the period in which the Romans held dominion in Scotland, it does not exceed two or three feet in depth, while in some it is found to have risen in the same space of time to the height of forty or fifty feet, we may fairly conclude, that the depth of the moss strata is not regulated by the length of time since the moss first began to be formed on that particular spot.

Dr. Walker says (page 15th) "It is to be remarked, that the deepest strata of peat are those which are placed nearest the level of the sea; whereas those at a greater height are comparatively thin; *this naturally results from a more luxuriant*

* This road has run off from that which led from Carlisle to Glasgow, at or near the Roman camps at Carstairs and Cleghorn, by Lanark, and been carried by Drawfin, Yards of Goslington, Wailshie, Linbank, &c. towards Ayrshire near Loudoun-hill. It was entire for several miles within the last twenty years, and is so still through the estates of Blackwood and Stonehouse, for more than a mile. Some remains of a bridge over Clyde, were discovered a few years ago near Milton, which, being in the line of that road, was probably built by the Romans. No bridge could be built there prior to the time that people held dominion in Britain, nor after their departure, till about the tenth or twelfth century; and if any had been built since that time, something would have been known concerning it. The bridge was probably formed of wood laid on pillars of stone.

x This bridge was found in the
 ruins of the Roman station of
 Milton, which is a fine ruin
 Wall

"vegetation of trees and plants in the one case than in the other."

The same author says (page 23d,) "It is natural to suppose, what appears to be the case, that the natural peat-stratum in Ireland, is in general deeper than it is with us, *from a greater mildness of climate, and a greater luxuriance in vegetation.*"

With all manner of respect for the venerable author, I am disposed to dispute the doctrine here stated, and the soundness of the philosophy by which he attempts to prove that doctrine.

I have seen, and can easily point out, many acres of moss, near the level of the sea, that had begun to accumulate as early as those in the centre of the island; and yet the moss-earth has not risen to the depth of three or four feet; in many places little more than as many inches: and I can shew in many places in the centre of the island, and in the highest elevations, beds of moss-earth ten times that depth. Moss Mulloch, in which I sunk rods forty feet without finding the bottom, is twenty-six miles from the sea, and in about eight hundred feet of altitude. Mosses in the parish of Shotts, at nearly an equal distance from the Atlantic and German oceans, and in more than fifteen hundred feet of altitude, have been found to be about forty feet in depth. In sinking coal pits at Wilsontown near the verges of Lothian and Lanarkshire, about eighteen hundred feet above the level of the sea, they have found nearly thirty feet of moss, even at a place where the moss was far from being level. The moss on the estate of Thomas Stewart, of Forth, Esq. marching with Wilsontown, has been found to be between thirty and forty feet deep. The moss of Blackburn, in the higher parts of West Lothian, was found to be thirty feet deep at one place where a pit was sunk; and it is evident, that some other parts of that moss must be deeper. The bog of Dullatur is at the highest level of the great canal between the Forth and Clyde, and nearly at an equal distance from the east and west oceans; yet it is found to be in some places fifty feet deep: thus it appears that Dr. Walker is in an error, in supposing that the deepest strata of moss are found at the level of the sea.

Dr. Walker is also in an error as to the causes from which deep mosses proceed. *Mildness of climate* is none of the sources

from which the moss strata rise to great depth; but the reverse. If mildness in the climate contributed to the depth of the moss strata, the deepest mosses would not be found in the cold regions of the north, nor in the temperate zones, but in the warmer climates nearer the line; on the contrary, we know, and Dr. Walker himself mentions the fact, that peat is only found in the temperate and cold climates, in both hemispheres, where the heat is not sufficiently strong to carry on the putrefactive fermentation to its utmost extent.

The reason is obvious: a genial climate produces rich and succulent herbage, which is more disposed to yield to putrefaction than that which grows in the cold and frigid regions of the north: were the quality of the herbage in both climates the same, still the greater degree of heat would accelerate its putrefaction, and more readily dissolve its parts, in the one than in the other. We know how powerfully moss-earth resists putrefaction, so long as it remains buried under a mass of that cold wet earth. But when a portion of it is mixed into a rich, warm, sandy, or gravelly soil, in a low situation, the heat of that soil will overcome its insolubility, and annihilate, in a few years, every fibre of the moss. If the mosses which now encumber the northern parts of Europe, were removed to the hotter regions of Asia or Africa, every particle of which they consist would soon yield to putrefaction.

Dr. Walker seems to understand this in its proper light when he affirms, (p. 24.) that "We find a remarkable difference in the putrefaction of peat, from the smaller vicissitudes of heat and cold in our climates; at the same level above the sea, the peat is every where more consumed in the south of England than in the north of Scotland; the natural consequences of a warmer climate. In the peat mosses in the lower parts of Scotland, the putrefaction is always more advanced, and the peat more consumed, than in the higher part of the country, where greater cold prevails." If the putrefaction is farther advanced, and the peat more consumed, the stratum cannot be thicker, but the contrary.

The plants from which moss-earth is formed, are not capable

of growing more luxuriantly in an increased temperature, than in one much colder. I have found the *Sphagnum Palustre*, *Erica Vulgaris*, *Bryum Hypnoides*, *Polytrichum Commune*, and the other plants which chiefly contribute to the formation of moss-earth, growing more luxuriantly in the highest regions of Caithness, Sutherland, and Inverness shires, than in the west or south of England; and I am informed, that they grow more luxuriantly in the countries bordering on the Baltic, than on the shores of the Mediterranean; they do not, and cannot grow at all but in cold regions, where much moisture is detained; they are not capable of growing more luxuriantly in a warm than in a cold climate; or if they were, they would more readily yield to putridity, and thereby diminish, not increase the depth of the moss stratum.

But some mosses, and some parts of every moss, are deeper than others: the fact is indisputable, and the cause requires to be pointed out.

The origin of moss-earth, and the diversity of the depth of its strata, may be traced to the same cause: moss-earth is only found in cold and temperate climates, and on such spots in these regions as are overcharged with moisture; it does not accumulate in any part in the warmer climates; neither is it to be found even in the cold climates, except when as much moisture is detained, as banishes the richer grasses. *Cold and moisture*, to a certain degree, are the sources from which moss originates; and the depth of the stratum is always in proportion to the rigidity of the climate, and the quantity of moisture detained on the surface.

It has been shewn, that where there is much acclivity, and the subsoil permeable, Hill-moss, of a few inches thickness, is all that has been collected since the commencement of vegetation. On ground not so steep, and where the subsoil is more close and retentive of moisture, a different kind of herbage starts up, and a deeper stratum of moss-earth is formed, usually denominated Bent-moss. Where the ground is nearly level, the soil retentive, and the moisture obstructed by felled trees, or any other incumbrance, the vegetable productions are

different from either of these, the accumulation of the moss-earth is much more rapid, and the species so formed, denominated flow-moss.

In every part of Britain, the climate is congenial to the growth of moss plants, and the accumulation of moss-earth; and if moisture, its other parent, is supplied in due proportion, moss-earth will be formed over any part of the Island; and the depth of the strata correspond to the quantum of moisture detained on the surface.

Wherever a moss is nearly level, and the outlets of surface-water obstructed, the moss-earth has accumulated, and is still accumulating with greatest rapidity; and where the ground rises more, and the moisture finds a channel to escape, the growth of the moss plants is slower, they are more disposed to yield to putrefaction, and of course, the depth of the moss bed advances slowly.

It is therefore in proportion to the quantum of moisture detained on the surface, that the moss-earth accumulates. Hence we find, that the deepest moss stratum is always found in places that are most level, and landlocked, so as to detain much moisture on the surface.

The moisture on the surface of the moss may increase the depth of the moss strata in three different ways: 1st. By raising tribes of plants which are bulky, and grow fast; 2d. By conferring on the herbage the powers of resisting or retarding putrefaction; and, 3d. By distending the moss-earth, and thereby adding to its depth.

All the plants which grow in or under water, are much more bulky than those which grow on a moss, the surface of which is relieved of stagnant water: the lake plants, it has been shewn, are very bulky. The *Sphagnum Palustre* is not bulky, but it grows in such clusters, that it soon raises the surface; so do the *Bryum*, *Polytrichum*, &c.

But these plants have also the power of resisting putrefaction much longer than those which grow on drier mosses. The *Sphagnum* remains nearly as bulky in the moss bed, several feet below, as it is when growing on the surface. J

have seen a peat cut several feet below the surface, in which the texture of the Sphagnum remained plain to the naked eye.

The moisture also distends the moss-earth, which is in fact a semiliquid substance. When channels are opened for the escape of the moisture, the moss-earth will sink nearly one half.

It is not therefore owing to the age of the moss, the heat of the climate, or the luxuriance of growth on that account, that the moss stratum is deeper in one place than in another. The age of some mosses which are shallow, is greater than of others that are deep: the climate is the same in both; but the diversity of depth in the strata proceeds entirely from the greater quantity of water having been detained on the surface during the growth of the moss plants, and formation of moss-earth from them.

Wherever a moss is nearly level, and no proper channel opened by nature or art, for carrying off the moisture, it will be always found to be increased in depth. But when the moss has risen above the level, the current of the water in times of rain, opens little courses, commonly called Hags, which every flood deepens, till they come near the level of the outlet. These hags in a great measure arrest the growth of the moss stratum; they relieve the surface, and the moss itself, to their own depth, of superabundant moisture, and the moss condenses and sinks considerably. The Sphagna and bulky aquatics cease to grow, and herbage less bulky, and more disposed to yield to putridity, rises on the surface.

SECT. X.

Of Moss-earth recently formed.

ALTHOUGH the age of moss cannot be ascertained from the depth of the strata, or state of the climate, the commencement of some part of the mosses may be traced from other

sources. The investigation, although not of the first importance to the practical Farmer, may amuse, and it can do no harm.

The British historians of the greatest antiquity, treat of little else but wars, feuds, battles, defeats and murders, or the stories and fabulous legends of priests. They say nothing of natural history, or the important concerns of agriculture. Something of the manners of our ancestors may be gleaned from the accounts given of their wars, and their religion, but little can be discovered regarding the subject of our present inquiry.

It is abundantly evident from ancient history, that about eighteen hundred years ago, the greatest part of the surface of Britain, and indeed of all the north of Europe, was covered with stately trees and forests of vast extent. It is equally certain, that the aboriginal inhabitants had not attained such knowledge in the arts as to enable them to clear out these forests. Their mode of life did not require their overthrow, as they were their shelter from invaders, and the places in which they caught their prey, and performed their devotions. They considered woods and groves as sacred, and they had not learned to cultivate the soil.

The Roman historians, whose authenticity none ever doubted, inform us, that the forests existed till their legions entered Britain, and their Generals cut them down to secure the conquest of the island. It must therefore be obvious, that few mosses existed in Britain before the Roman invasion.

The growth of moss is no doubt a process of nature, and its laws have not been altered by the conquest of the Romans. Moss plants would no doubt grow and contribute to the formation of moss-earth, as well before as after that event. Lakes of a moderate depth, and the sides and skirts of hills that were not covered with trees, would as readily acquire a bed of moss-earth then as since. When any part of a forest was overthrown by the winds, moss would rise over it, as readily as over the trees cut down by the axe of the Romans, or that of others who followed their example.

But as by far the greatest part of the island was covered with forests at the time of the Roman Conquest, I conceive myself warranted in stating, that comparatively few mosses existed in Britain, till after the Romans had cut down the woods. After they had taught the natives to make and use the axe, every subsequent warrior applied it to the destruction of the forests in the countries he invaded, till none of them remained standing. To these warriors we are indebted for the mosses which now encumber so much of our soil. The woods were not cut down to enlarge the operations of agriculture, for that science was neglected; or if the forests had been overthrown for that purpose, the ground would have been cleared and moss would not have risen over it.

For these reasons I consider the origin of the greatest part of the mosses in Britain, as commencing with the overthrow of the forests, begun by the Romans, and completed by subsequent warriors. It would be endless as well as impossible to ascertain the precise period at which the forests in every particular part were cut down. In many places their overthrow, and the commencement of the formation of moss are much more recent than is generally believed.

Wherever mosses, farms, or districts now covered with moss, bear the name of *wood*, *forest*, *bank*, or any other term in the English or Saxon languages which denotes *wood* or *forest*, no doubt can remain, but that every such farm, or district, was covered with a growing wood or forest, at, or after the period at which the English or Saxon languages were introduced and generally spoken in that part of the country.

The Saxons obtained a footing in the Lothians soon after the time of their settlement in England. But the language referred to, was introduced into Scotland by the Dano-Saxons, between the 9th and 11th centuries, and it did become the general language of that country, till after the invasion of Scotland by Edward I. near the end of the 13th century. It must therefore be evident, that wherever mosses in Scotland (except in the Lothians) bear the name of *wood*, &c. that ground where these individual mosses now rest, was covered

with growing woods after the 9th, and probably after the 12th and 13th centuries.

To name all the places in Scotland still bearing the name of wood, and now covered with moss, would occupy many pages. In the parish of Carnwath alone, we find one large farm named *Woodend*, one named *Highbwood*, two bearing the names of *Hinds-hill-wood*, two denominated *Syde-wood*, one termed *Girt*, or *Great-wood*, another *Girt*, or *Great-wood-end*, one called *Haniswood*, and another *Hartwood*. All these are extensive farms, on which scarcely a tree exists, and where the greatest part of the original soil is enveloped in moss earth. I could point out hundreds of such instances; some of them will occur to every reader. The forest of Paisley, which existed in the 12th century, has since been laid low, and overgrown with moss. But the names it bore before that change still continue, as, *Woodside*, *Oakshawbead*, *Oakshawside*, *Linwood*, *Fulwood*, *Birkinbead*, *Woodbead*, *Wakingshaw*, &c. In the charter of foundation of the Monastery of Paisley, the great Steward conveys to the Monks, all the tithes of the lands *below the forest of Paisley*;" the words of the charter are "*Decimas de omnibus terris infra forestum suum de Pasleto*. In Pryn's Collection, mention is made of "*John le Hunter, de la foreste de Pasles*." As late as the year 1450, and 1524, the tenants of Dunscaith-wood, in the vicinity of Paisley, were bound by the Abbot "to keep the wood or forest, and uphold or repair the dikes round the forest." This forest when entire would communicate with the forest of Selkirk, situated at the sources of the Aven. In ancient times, the woods extended without much interruption from Paisley, through the higher parts of the shire of Renfrew, the marches of the shires of Air and Lanark, by Loudoun hill, &c. and continued till near the shores of Galloway. The whole wood in that extensive tract has been long ago cut down, and where it grew, mosses now lie. This is probably one of the largest tracts of moss in Britain.

The upper parts of the parish of Avendale, marching with Muirkirk, formed part of the forest of Selkirk, so often men-

tioned by our Scottish historians, between the 10th and the 14th centuries. That forest extended from the county of Selkirk to the town of Air, comprehending the upper parts of Airshire, Clydesdale, Peebles-shire, &c. as far as Selkirk. Of course, the southern and western parts of the parish of Strathaven, and higher parts of Lesmahagow, must have formed part of that forest. Hemingford says, page 165, "*Devenerunt nostra per medium foresta de Selkirk, usque ad castellum de Are.*" Vide Hemingford, and the learned Lord Hailes, in his Annals of Scotland, vol. i. page 260, says, "the forest of Selkirk appears to have comprehended not only the tract now known by that name, but also the upper parts of Clydesdale and Airshire." Many other authorities might be quoted, but these will suffice to show, that the upper parts of Strathaven and Lesmahagow parishes, formed part of the forest of Selkirk. That this forest was in existence in the 12th century, and since, is well known to all who are acquainted with the history of these periods.

That the western parts of this forest, particularly what now forms the parishes of Sorn and Muirkirk, which march with Avendale, were a growing forest in the end of the 12th century, is proved beyond all doubt, by a charter, granted by Walter, the Grand Steward of Scotland, to the Cistercian monks of Melrose, in the year 1180. In that charter, the Steward conveys to the said monks, in pure alms, for the health of his own soul, and those of some of his relations, the lands of Mauchline, &c. with the whole pasture of my forest, as far the marches of Douglas, Lesmahagow, and Glengivel. The words of the charter are "*Per divisas suas, inter terram de Mauchlin et terram Gilberti, filii Richeri, cum tota pastura foresta sua usque ad divisas de Douglas, et Lesmahagow, et Glengivel.*"

The lands conveyed in that charter lying between Mauchline, Douglas, Lesmahagow, and Glengivel, are what now form the parishes of Sorn and Muirkirk, in the higher parts of the shire of Air. Douglas, Lesmahagow, and Glengivel, form part of Lanarkshire, which was included in the forest of Selkirk. That these were a growing forest in the year 1180, will not be doubted by any one who reads the charter above quoted.

This fact may also be established beyond a doubt, from the names of farms in that quarter. Though very few trees now grow in Muirkirk, or the upper end of Strathaven parishes, and though four-fifths of the whole surface in these quarters are now covered with moss, yet the greatest part of the lands is named by *wood*. In the parish of Muirkirk, three very large sheep farms, each of them containing many hundreds of acres of moss, are denominated Upper, Nether, and Mid, *Well-woods*. Other farms as large, and equally over-run with moss, are likewise named from wood; as, *Ashyburn, Harewood, Netherwood*, Middlefield in *Netherwood*, Lamingburn in *Netherwood*, Burnfoot of *Netherwood*, *Beblon Woodhall*, Waterhead in *Netherwood*, *Birklaw Aikler*, &c. The largest water in that parish, is termed the *Green-oak-water*, and several farms in its neighbourhood, now also covered with moss, have the same name, as *Green-oak-mains, Green-oak-dyke*, &c. Besides these, which are all large sheep farms, we find many extensive tracts or fields, parts of other farms, where the moss has arisen high above the timber, and where no trees now grow, still named by *Wood* or *Bank*, which in that part of the country bears the same meaning, such as *Birkin-bank, Cow-bank, Trintle-hill-bank, Wood-hill, Wood-meadow, Woody-trough, Aiken-cleugh, Thorny-run, Thorny-hill, Saugh-bush-hill, Birkin-runner, Gowk-thorn, Ashy-hurst*, &c.

When we turn our face towards the Aven, we find on the higher grounds, which made part of the forest of Selkirk, many farms and fields, on which scarcely a tree has grown for several centuries, and which are mostly covered with moss, still named by *Wood* or *Bank*, which are synonymous terms. Some of these names are of Celtic etymology, but most of them are in the Saxon language. Of the former, we find several extensive moor-farms, mostly covered with moss, denominated *Hair-shaws*, * *Hair-shaw-head, White-shaw, White-shaw-gate, Berkin-shaw, Shaw-head*, several *Shaw-touns*, and *Shawten-hills*,

* *Shaw* is the Celtic word for wood.

Calder-water, † *Calder-green*, *Calder-crooks*, *Calder-mill*, &c. In the Saxon tongue, we find on the southern parts of Strathaven parish alone, where it marches with Muirkirk, fourteen farms, most of them of great extent, and where moss covers the greatest part of the surface, denominated *Lin-banks*, *Hawk-woods*, *Bank-end*, *Kirk-woods*, *Hazel-banks*, and *Aller-stocks*. We also find *Black-wood*, *Nether-wood*, *Wood-head*, several *Hazel-deans*, *Edle-wood*, *Over-wood*, &c.

These prove, beyond all doubt, that the farms so named, were covered with growing wood, when the names they now bear were first conferred. No people could, in so many instances as have been mentioned, and in thousands more that might be pointed out, in all the counties of Scotland, denominate *mosses*, by the name of *wood*, unless there had been reason for imposing these names. Names conferred by a rude people, are generally much juster, and much more descriptive of the thing named, than those conferred by a people who have made greater progress in refinement. A savage people have but few words in their vocabulary. Our Celtic ancestors were remarkable for giving names the most descriptive. Dr. Smith observes, that every thing in their religion was more clearly explained in the etymology of the name, than they can be in ours in a long theological lecture. "The names of farms, hills, rivers, &c. in the Celtic tongue, never fail to convey a clear and correct description of their situation or aspect.

The wood still to be seen in all these mosses, and the roots of the trees in the subsoil, prove the existence of the forests where the moss now lies. As no doubt can remain that the present names were conferred when the woods were standing, if we could only discover at what time these names were first given, we should thereby be able to fix a period *within which* the wood must have been growing, and the moss not begun to be formed.

Such of the names as are of Celtic derivation afford no data on this head. But such of them as are of Saxon or English origin, could only be given after the introduction of these

† *Calder* is the Celtic word for *water wood*.

languages into this part of the kingdom. Indeed, a language must have come into general use, before farms and fields could be named by it. For names of such places, in parts so remote, are not conferred in the language of the court; but by the most illiterate of the peasantry, in the homely style of their mother tongue, and always from something the most striking in their aspect or situation.

The English language was first introduced into Scotland, by the Dano-Saxons, between the 9th and 11th centuries. But it did not become the general language of the country people, until after the conquest of Scotland by Edward I. near the end of the 13th century. It is no way probable, that the English language would be soon introduced into that remote district. The country is mountainous, barren, and but thinly inhabited. It is the extremity of two counties, which had for many centuries been peopled by two hostile nations; and on that account, it is probable, that a considerable tract next the march on both sides, would remain uninhabited, till these nations were blended into one about the 9th century. Prior to the invasion by the Romans, the *Novantes* inhabited Galloway and Airshire, and the *Damnii* occupied Clydesdale. After the Romans abandoned the island, Galloway and Strathclyde continued, till the time of Kenneth McAlpin, to be inhabited by two hostile nations, who waged terrible wars against each other. Both of these nations were Britons. The Saxons never obtained a footing in that part of Scotland, so that it was impossible the Saxon language could find its way into these remote parts, till after the conquest of Scotland by Edward I. in the end of the 13th century.

When I consider that the moors of Muirkirk, and higher parts of Avendale, formed part of the forest of Selkirk, which is well known to have existed in the 13th and 14th centuries; when I look at the charter by the Steward, quoted above; and when I find so large a proportion of the land in these regions still named by *wood*, in the Saxon language; I am warranted to conclude, that the parishes of Sorn, Muirkirk, and the high-

er parts of Strathaven, Lesmahagow, Douglas, &c. now almost wholly covered with moss, were all growing forests, at, and after, the end of the 12th century.

As to the precise time when the extensive woods in these quarters were cut down, or by whom that great work was executed, I can offer no opinion. It is well known, that King Robert Bruce wandered for some time in that neighbourhood, with his army, after the battle of Loudoun-hill. But whether the English cut these woods after that period, or during their inroads under Baliol, in the unhappy reign of David Bruce, to prevent the Scots armies from flying again to such a strong hold; or if they were cut to extirpate the wolf, are matters on which I can form no conjecture.

When the church of Craigie was built, at, or soon after the Reformation, the forest of Selkirk was entire from near the town of Air to that church; hence it was long termed "*the Kirk of the forest*," and is still known by that name. Dalrymple-wood, and one on the sides of Loch Martnaham are so much of that forest yet preserved. The banks of the waters of Air and Douglas, and many of those of the rills that fall into them, are still ornamented with some poor remains of that forest, greatly diminished within the memory of many yet alive, and daily dropping off. Some of the glens at the sources of the Clyde, the Tweed, and the Annan, preserve remnants of the forest, which in former ages covered that whole range of country. The banks of the Nith, and all its tributary rills have to this day some pitiful remains of this once extensive forest. The natural woods which grew on that river about thirty years ago, had they been preserved till now, would have brought many thousands to the proprietor. They were cut down by the present Duke of Queensberry, on his succeeding to the Estate. Had the ground been then enclosed, or the young trees defended from the depredations of cattle and country people, they would have continued to grow an ornament and shelter to the country, a treasure to his Grace, his successors, and the nation. When any proprietor so much disregards his own interest and that of the nation at large, as

his Grace has done in this instance, it is certainly proper for the Legislature to interfere. Had the sum of £500 been then laid out with judgment in fencing the natural woods on the Nith, they might, in thirty or forty years more, have been worth several hundred thousand pounds to the proprietor, and still more to the community. But they are in a great measure lost to both. The conduct of his Grace in that instance cannot be sufficiently execrated.

But however the forest of Selkirk may have been cut down, no doubt can be entertained, that the overthrow of these woods led to the formation of the mosses which now cover the greatest part of the surface in that part of the country. What an unprofitable exchange ! The growing wood would have sheltered and greatly beautified the country, mended the climate, and proved a vast treasure to the owners, and to the public ; while the moss which has risen over it is of little use as a soil, and has very injurious effects on the climate.

The Rev. Dr. Rennie, in his Essay so often quoted, has brought into view some things on this subject which might have otherwise escaped me. They are so much in point, and so properly stated, that I beg leave to copy them verbatim from the pages 78th and 79th of his Essay.

“ Dr King, in his account of the Irish mosses, mentions several instances where there appears the clearest evidence of their recent origin. I name one. There are many bogs of late standing in Ireland. When O'Donnel and Tyrone came to the relief of Kinsale, they wasted the country, especially as they came through Connaught, which by means of the Earl of Clanricarde was generally loyal ; and there is a great tract of land now a bog, which was formerly a ploughed field. There remains the mansion house of my Lord in the midst of it.”

“ Dr. Boates in his natural history, likewise mentions, that many of the present bogs seem to be of recent origin ; he states the following instances :—“ Under a bog five or six feet deep, a proper soil, with the marks of the plough, and the form of ridges, was discovered.” He adds, that there

"are few bogs removed but bear similar marks, particularly in Armagh, Dundalk, Londonderry and Donegal." He says, "that in the latter, a plough was found very deep in a bog, and a hedge with wattles standing five or six feet deep." He mentions, "that there are reports, that the streets and footsteps of a large town may be traced under a moss in the north of Ireland."

"M. De Luc mentions an instance on the Continent which also deserves attention. He says, "that in digging a ditch in Davelsmoor, at the depth of four feet in the moss, was found the subsoil; that this formed an inclining plane. In this was found a trough, or water-run, made of planks of wood, which showed that it was a malt trough. In the sand near that trough, a wimble was also found. He says that he saw it, and that it differed nothing from a carpenter's wimble."

"Here, he observes, is not only four feet of moss of recent origin, but a much greater depth: for all the lower level at which this trough terminated, and in which the mill stood, is covered with moss."

Dr. Rennie very justly remarks, "that the introduction of mills is of modern date in Europe, and the probability is great that the above moss is of very recent origin; it must have been posterior to the erection of that mill."

I might quote in proof of the doctrine laid down on this subject, the well known account given of the Earl of Cromarty, who says, in a letter to Sir Hans Sloane, inserted in the 27th vol. Philos. Trans. Anno 1711, page 296th; that in the year 1651, when he was nineteen years of age, he accompanied his father, on the family Estate, in the parish of Lochbroom, in West Ross, where he saw a plain covered with a standing wood of firs, but so old that they had neither leaves nor bark; that returning fifteen years afterwards, he found the trees overthrown, and the whole plain covered with green moss; and that in the year 1699, he found the people digging peat for fuel, from that same spot.

I might also quote an account given by Dr. Walker, page

19th, of part of the wood of Drumlanrig being overthrown by a hurricane in 1756, and the trees that were allowed to rot on the ground, being now nearly ripened into peat earth.

Both these cases are exactly in point. But without wishing to throw the least reflection on either of the reporters, I am bound in candour to say, that I am convinced there has been a great mistake in both cases.

That mentioned by the Earl of Cromarty rests on his authority; and his veracity cannot be doubted. But as this was in a remote district, which he seems to have visited only three times during his life, it is possible that his Lordship may have committed a local mistake. The place where he saw the old trees when a young man, may have been different from that where he saw the peats cut, when old. I am a proselyte to the theory his Lordship lays down, but I cannot believe that a standing wood could be entirely covered with green moss only fifteen years after, or that peat could be cut from that moss in thirty-three years more. If a standing wood could be formed into a moss fit for cutting as peat in half a century, other instances must have occurred. The Earl must, in my opinion, have been mistaken as to the place.

The case mentioned by Dr. Walker, to have happened at Drumlanrig, I have inquired into, and discovered that the Doctor has been altogether misinformed on that subject. Some trees were blown down there at that period, and have been suffered to rot where they fell, but the formation of moss over them is not yet perceptible. On seeing what Dr. Walker had said on that subject, I wrote to Thomas Yorstoun, Esq. Factor to his Grace the Duke of Queensberry, for information on that subject. That very intelligent Gentleman informed me, that he did not dispute the theory of Dr. Walker, but that it could not be proved from any thing which had happened at Drumlanrig. Not satisfied with this, I went to the spot, and from ocular demonstration, found that no moss had been formed over the trees which had fallen at the time the Doctor mentions. I was satisfied of this before I published the first Edition, but I did not wish to controvert facts stated by au-

thors so very respectable. I was satisfied that their philosophy was sound, though they had attempted to support it with evidence that was unsound : but now that these stories have been since related by others, I think it proper to state what I know concerning the one, and firmly believe as to the other.

PART II.

QUALITIES OF MOSS.

I HAD occasion to notice in my former publication on this subject, that information, as to the principles and qualities which are to be found in moss-earth, was extremely limited. It would be of the utmost importance to know what are the essential elements or substances of which moss is composed; how these are collected and united into plants, by vegetable organization; what are the chemical principles to be found in moss-plants, either when they are fresh or when they have undergone partial or more complete putrefaction. Till such information shall be obtained, the uses to which moss is capable of being converted, must remain in a great measure doubtful. Whatever may come to light by accident, no regular and well digested system of operation can be laid down and acted upon with much confidence, till, at least, some general knowledge shall be acquired, both as to the constituent principles and chemical qualities of moss-earth in all its stages, from the first formation of the vegetable fibre, until it is completely dissolved by putrefaction. It would also be of great importance to have it ascertained, what are the substances which act most powerfully, either in promoting the growth of moss-

plants, or in accelerating or retarding their decomposition, by putridity, after they have ceased to grow.

Important, however, as such information would be, it has been but little sought after by those who were best qualified to make such investigation, with prospects of success. Some slight researches had, indeed, been made by a few individuals, and some useful hints had been given; but meritorious as these might be, they were far from being adequate to the importance of the subject.

It is only to men conversant in science, that we can look for the information so much wanted. Of these but few have turned their attention to the subject, and some who have done so, have prostituted their abilities and erudition, in support of fanciful theories and extravagant speculations, tending to involve the subject in still greater obscurity.

As this publication has been so long delayed, I was in hopes that the Rev. Dr. Rennie would have removed these grounds of complaint, and laid before the public the most ample information as to the qualities of moss. In that, I have not been altogether disappointed. He has not indeed discovered any new qualities in that substance, from what had been formerly pointed out, except colour of moss and moss waters, and that no living animal is found in it, things which had been noticed by others, but which would not have occurred to me to rank under the head of qualities. But he has certainly traced the different qualities, which have been mentioned, farther than any who have gone before him. I wish, however, that he had investigated these matters more completely himself, by chemical and agricultural experiments, and given us less of the theoretical speculations of continental authors. I should be sorry either to insinuate doubts of the accuracy of the statements of the authors whom he quotes, or that he has been too credulous in his belief; but some of the accounts given of mosses taking fire on the surface of waters, and four feet below that of the moss, and this happening more readily when laid under the greatest quantity of moisture, and no water being able to extinguish such fires, &c. seem to refer to mosses so

very different from any thing to be met with in Scotland, and appears to border so much on the marvellous, as to mar the usefulness of the learned and diligent researches of the Rev. Doctor among the cultivators of moss land in this country.

I have long wished to see some eminent Chemist turn his attention to the qualities of moss-earth, with a view to ascertain how it could be rendered productive of grass, grain, or roots, or how it could be brought under more rapid putrefaction, so as it might be rendered efficient as a manure. I wish to see chemistry brought to the aid of agriculture. But, I do not see the advantage which cultivators of moss can derive from details of phenomena, which have occurred in distant parts of the world, and which, though interesting in Natural History, are foreign to agriculture; and the introduction of too many of them, without much more useful matter, into a work designed for the use of farmers would not, in my opinion, promote the important end of agriculture.

I formerly confessed my inability to make the analysis, which I conceive to be necessary; and though I have, since that time, turned my attention with ardour to the study of Chemistry, as far as it was possible for a person to do, whose residence is in a remote corner of the country, beyond the reach of public instruction, and who is deprived even of the proper means of improvement by private study; yet, I cannot depend upon any experiments which I can make under such disadvantageous circumstances.

I do not see the utility of retailing, in technical terms, the partial experiments of others, which, whether correct or not, can be of no use in agriculture. All that I shall yet attempt is, merely to name the qualities, which are most perceptible, and which relate to the moss-earth, in the eye of a cultivator, as *Inflammability, Insolubility, Antiseptic quality, Acidity and Tenacity.*

CHAP. I.

THE QUALITIES OF MOSS-EARTH, WHICH ARE PLAIN AND OBVIOUS TO ALL WITHOUT ANALYSIS.

SECT. I.

Of Inflammability.

INFLAMMABILITY, or the quality of catching fire, which is found in some of the productions of nature, but not in others, proceeds from certain substances which Chemists term Simple Inflammables, as, *Carbon*, *Sulphur*, and *Phosphorus*, with their Binary Compounds. One or other of these substances, or of the various compounds into which they enter, must be the cause of that inflammability which we find in moss. Some small portion of Sulphur, or of the combinations into which it enters, may be detected in some mosses, by the smell which it emits in burning; but I apprehend, that it is but a small proportion of Sulphur, which is to be found in the generality of moss. Phosphorus, which is sometimes found in mosses and marshy grounds, is what country people call wild-fire, or *Spunky*, (*Ignis fatuus*.) But I do not suppose, that the inflammability, which renders peat useful as fuel, proceeds, in the least, either from phosphorus or any of the compounds into which it enters. Carbon and its various compounds, I imagine, are the chief cause of that inflammability. But this will be ascertained when a proper Analysis of moss-earth shall be made by those who are better qualified for the task.

Before leaving this subject, I shall take notice of some things which have been advanced by others, who have written on moss and its qualities.

Dr. Anderson and Degner, whose notions, it seems, he has adopted, have endeavoured to refute the generally received opinions of Philosophers, as to the vegetable origin of moss-

earth, and denied that moss becomes more inflammable, as putridity advances. Dr. Anderson says, "It is well known, that when vegetables have once fallen into a state of putrescency, their inflammability decreases in proportion as that putrescency augments. Yet, as moss becomes more putrid, it becomes more inflammable, which is directly the reverse of every well known process of nature in every other case. Were such arguments to be admitted in physics, there would be an end to all reasoning entirely. For it is an insult on reason to say, that you will argue from analogy, while you go directly contrary to every known law in nature that ought to constitute that analogy."

But after all which the Doctor and the Dutchman have said on the subject, nothing is more certain, than that as putrefaction advances on the vegetables of which moss-earth is composed, its inflammability is *increased*, and as it advances on any other species of vegetables, their inflammability is *decreased*. This is not, as they assert, either an insult upon reason or contrary to any well known process of nature. It is the result of the very laws implanted by nature in these parts of the vegetable kingdom. How nature conducts these processes, so very different in the one species of vegetables from that of the other, I shall not take upon me to determine, but the fact is indubitable to every person of common observation. In so far as I can perceive, the plants from which moss is composed, are, when growing or recently formed, no more inflammable than the grasses or other vegetables which grow on dry land. But whether the inflammable ingredients found in moss-earth are collected, during the progress of putrefaction; or if the vegetables, of which that earth is formed, retain the whole of their inflammable ingredients, and only part with those which are of a different quality, while the other vegetables do the reverse, are questions which I am not able to answer. But, however that may be, there can be no doubt, that as the plants which grow upon, and contribute to the formation of moss-earth, go into putrescency, they become more inflammable, and that all other plants lose their inflammability as putrefaction advances.

Mr. Naismith, indeed, seems to think that moss, or peat as he terms it, is possessed of inflammability only *in common* with other organic bodies of the same origin, and that those who imagine there is any thing extraordinary in the inflammability of moss, are in a mistake. If that intelligent Gentleman means, that moss-plants, and those which grow on dry land, are, when recently formed, equally inflammable, and that the former lose their inflammability as putrefaction advances, while the latter retain it, and only part with the other ingredients or substances of which they are composed, I could not take it upon me to dispute the averment. But, if he mean, that moss-plants are as inflammable as moss-earth, when the organic texture of the plants has been, in a great measure, reduced by putrefaction, I would have no scruple in saying that he was in a very great mistake.

The upper strata of moss-earth is not nearly so inflammable as that below. Hence it is generally laid aside, when moss is cut for fuel. Dr. Rennie observes, that peat on the surface and coal at the out-burst are less inflammable than the rest, and that peat, when long exposed to the external air, loses its inflammability altogether. This, however, must be understood with limitations. A piece of moss-earth, if kept dry, may be exposed to the external air, for centuries, without losing any part of its inflammability. But, if it is dug up, separated from the mass, and exposed to all the vicissitudes of the weather for a few years, it will certainly become, in a great measure, uninflammable. If it is exposed to much frost and rain when newly separated from the common mass, and before it is dried into peat, the progress of putrefaction and decrease of inflammability will be much more rapid than when the moss is dried into peat before it gets frost or much rain. But even peats, which have been fully dried, will, when long exposed to every vicissitude of the weather, ultimately yield up their inflammability, and melt into loose friable earth, especially those which are cut from flow-mosses, in low level situations overburdened with moisture.

The moss-plants on the surface, however, and even the

upper stratum of moss-earth, though they are exposed to the external air, and every vicissitude of the weather, until other strata accumulate over them, are not thereby deprived of their inflammability. It is true, that moss-plants and moss-earth so situated, are not, as Dr. Rennie and Mr. Naismith remark, nearly so inflammable, or do not burn with such heat and durability as moss a few feet lower in the stratum. But this does not proceed from the inflammability having been reduced by the external air, or even by the frosts, thaws, and other vicissitudes of the weather. The fact is, such moss-earth and moss-plants have not, in that state, attained the degree of inflammability, which they are capable of attaining, and that they will attain, when putrefaction has made greater progress. If moss in such situations were deprived of its inflammability, no moss would ever be inflammable; for all the moss, in the deepest strata which can be met with, was, at one time or other, exposed on the surface in the same manner, and was then equally unflammable. But when other crops of moss-plants have risen and been formed into moss-earth over it, its putrefaction and decomposition gradually advance, and if the moss remains unbroken, and the vegetable matter is not washed away by the rains, exhaled by the sun, or taken up by the roots of growing plants, the inflammability of the moss-earth is increased, as putrefaction advances on the organic texture of the moss-plants. But if a small piece of moss is exposed by itself to the severity of the weather, its tenacity is reduced, and its texture and adhesion broken, by alternate frosts and thaws, rain and drought, and if the rains wash away its juices as they are formed, and the sun exhale its gases as they are thrown off, its inflammability will be gradually diminished, its insoluble and antiseptic qualities overcome, and its organic texture reduced, until the whole moss, so exposed, will, in the course of time, be annihilated the same as any other vegetable matter.

Dr. Rennie is of opinion, that Hydrogen and Carbon, which form the elementary principles of all sorts of Bitumen,

are the chief causes of inflammability in moss-earth. Hydrogen, no doubt, exists in the plants which form moss-earth, as well as in other vegetables, and perhaps from the low temperature of the moss, or some other cause, that Hydrogen, or other inflammable matter in the moss plants, is not evolved or carried off in a gaseous state; but continues in the partially decayed remains of that species of vegetable matter. If the other ingredients or elementary principles, of which these organized vegetables are composed, are exhaled, washed off, or otherwise removed: or if they enter into new compounds more inflammable, as putrefaction advances on the original moss-plants, the increase of inflammability in the moss-earth, as putrefaction advances, is easily accounted for. And that it must be in one or other of these ways seems to me obvious.

I cannot, however, concur in opinion with that ingenious Gentleman, that inflammability is increased by the moss being buried under water. So far from that being the case, I am confident, that of all the mosses to be met with, those which are under the least moisture, either when the plants are growing or after they begin to decay, are the most inflammable and form the best fuel. And those which are laid under much moisture, have least inflammability, and make the worst fuel. Bent-moss, for instance, or that which is covered with crops of coarse green bulky herbage, as, White-bent, Stool-bent, &c. and which is so thin as not to be capable of being cast in a breast *ferret*, but the peats must be cut perpendicular, or what is termed under-foot, and where the whole stratum is not more than fifteen or eighteen inches in depth; the moss is always the most inflammable, and makes, by far, the most durable fuel. This description of moss is never laid under much water.

Of all the kinds of moss that can be found, that which grows in or under water, is the least inflammable, and of the smallest value, either as fuel, manure, or a cultivated soil. Moss formed of bulrushes, reeds, water-lilies, and other aquatics, which grow in shallow waters and sink under them, till the lake is filled up to the surface of the water, are nearly void of inflammability, and incapable of being used as fuel.

Even the moss-plants, which grow in the stanks and gutters of level flow-moss, and which are chiefly the *Sphagnum Palustre*, *Bryum Hypnoides*, and *Polytrichon Commune*, form a sort of moss, which no person will use as fuel who can come at any other. It is of a white colour, open, spongy, soft, and light, and though it catches fire and burns when dry, it yields little heat and is soon exhausted. It is not fit to be used as fuel.

Dr. Rennie talks much about the "high degree of inflammability of all *low lying level mosses*," He says, "We might expect *a priori*, that the longer such mosses were soaked in water, the more inflammable they would become. Hence moss is more inflammable in proportion to the moisture it contains." He thinks, that when the water from other moss or moorish ground runs upon and overflows these level, low lying mosses, it will leave a sediment, or otherwise promote the inflammability of the mosses which it overflows. But I can assure the Rev. and intelligent Doctor, that moss is inflammable and valuable as fuel, exactly in proportion as it is kept free of moisture, and that it loses its inflammability, and its value as a manure is diminished, according as it is laid under moisture: and that whether such moisture come from moss ground or any other soil. No man will cut peats out of such low level wet mosses, who can find any that are drier; and no good peat was ever obtained from mosses which were so situated at the time, in which the moss was formed. Water is, no doubt, as this respectable Author says, the mother of moss. Moss will never be formed but where too much water for richer herbage is detained on the surface. But the value of the moss for fuel will always be found to be greatest where it is kept under least water, during the formation of the moss, and *vice versa*.

Dr. Rennie quotes Venel, who says, "That peat is slow of kindling, and emits a smoke at first which extinguishes flame." I do not know where Venel met with peat of that description. I never saw any such thing, except when the peat was not sufficiently dry. Some peats give a strong and

lasting heat, and others yield less heat and are speedily exhausted. But all of them kindle faster than any other species of fuel, dry wood not excepted. All peats, like wood, coals, or other combustibles, emit some smoke, when first put on the fire; but that smoke does not extinguish flame as Venet asserts.

A great deal has been said about wood being rotted to a pulp, and still as inflammable, or more so, than when sound, and the conclusion drawn is, that this wood which must have lost its own natural inflammability, has been supplied in that quality by moss. I have never seen any wood reduced to the state of pulp, except the Birch, Alder, or some of the aquatics, and they were, no doubt, still inflammable, that is, they would, when dry, readily catch fire and burn to ashes. But they would not yield much heat, and would only burn for a very short time. I never met with oak wood in that soft pulpy state. I have seen part of it on the outside above, a good deal rotted; but there was always some part of the tree sounder, and so solid, that it could not be cut with a spade. But at any rate, I have always found the soundest parts of these fossil trees to be the most inflammable, and to make the best fuel. The rotting or reduction of the organic texture of the tree does not, in the least, add to its inflammability, as has been asserted, but the reverse. The sounder the better fuel; and a piece of wood dried, when newly cut, would burn longer and yield more heat than any moss timber of the same species. Fir wood is no way impaired by remaining many centuries enveloped in moss, and it is by far the most inflammable of all sorts of fossil timber.

The inflammability arising from Phosphorus, and that which spontaneously kindles mosses at four feet below ground, and on the surface of the lakes or ponds of water on which the mosses are said to be suspended, and the impossibility of extinguishing such fires by means of rivers of water, are Phenomena, on the consideration of which I shall not enter. No such things have, so far as I know, happened in Scotland, except the *Ignis fatuus* or *Spunky*, which are not confined to

moss; and if they had taken place here, still they are no way connected with that inflammability, which renders moss useful as fuel, nor with agricultural inquiries. Neither can I account for the extraordinary inflammability of the stiff clay which Dr. Rennie mentions to have taken fire, in the neighbourhood of Kilsyth, and continued to burn, with irresistible fury, until ditches were cut to arrest the flames. Of all other soils, I should have supposed clay to be the least inflammable, and the least likely to take in the inflammability of moss or any other matter whatever. Dr. Rennie supposes this to have proceeded from the oils, gums, and resins of the moss, becoming soluble and penetrating the tenacious clay in the subsoil; but I never saw oil in moss. If it contain gum or resin, I never saw them exsuding from the moss, neither could I expect, that they would readily penetrate a subsoil of tough tenacious clay.

SECT. II.

The Insoluble and Antiseptic Qualities of Moss.

THE insolubility of moss is obvious to the most inattentive. It is owing to this quality that it exists. It has been appointed not only for animals, but also for vegetables, first to die, and after death to undergo decomposition. All other plants spontaneously and speedily undergo that change. Their organic texture is soon dissolved, and the substances of which they were composed, are separated and entered into new combinations. But the plants of which moss-earth is composed, though they cease to grow after having attained perfection, and though they soon begin to yield to putrefaction, and the organic structure of some of them is reduced; yet the substances of which they were composed, are neither washed into the soil and taken up as the food of plants, nor exhaled by the sun; but continue in a sort of pulp or black earth, mixed with the re-

remains of others of the plants which have not yielded so completely to putrefaction, and of which something of the organic texture is still visible. It has been already shown, that it is owing to this quality in the plants, which grow upon and compose moss, that we meet with that substance on the face of the earth.

The discovery of the nature of insolubility in moss-plants and moss-earth, and of the means by which it could be removed, would be not only the most important thing regarding moss; but it would be, in my opinion, by far the most interesting discovery ever made in agriculture, or probably in any other science. It is insolubility in the plants of which it is composed, that has formed moss-earth. If the power of removing that quality could be discovered, it would not only enable us to remove that nuisance and incumbrance from the face of the earth; but the whole of our mosses being composed of vegetable matter collected and accumulated for ages, they might become valuable as manure. In fact, such a discovery would convert all our mosses, hitherto of no use, into so many immense dunghills.

The antiseptic quality of moss is evident in its resisting putrefaction, and preserving every substance which is buried in it, from being reduced by that otherwise irresistible Destroyer of the organic texture of animal and vegetable bodies.

Wood, when exposed to the vicissitudes of the weather, or buried in any kind of earth except moss, is annihilated by putrefaction in a few years; but when covered with moss-earth, it is preserved from farther putrefaction for any length of time. Trees which are found in moss, are often dissolved to the centre in the upper side. But this must have happened before the moss grew over and covered them. When a tree is enveloped in moss, while it is yet sound and unimpaired, it will remain so for many centuries.

Cloth buried under moss is preserved sound and unimpaired for any length of time. Some iron-heads of arrows, wooden bowls, three sacks full of nuts, and a coat of an ancient texture and construction, were, in the year 1737, dug from under a

moss fifteen feet deep in Ireland; and all of them were in a high state of preservation (*Archæologia*, Vol. VIIth. p. 3.) A piece of cloth dug from under moss ten feet deep, on the lands of Flatt, in the parish of Glassford, Lanarkshire, was found to be fresh, and well preserved. This piece of cloth was brought up from the bottom of the peat forest, on the point of the peat-spade; but the incurious labourer was neither at the pains to preserve it, nor so much as to examine if any more clothes were deposited in the same place. Probably this might be part of the clothes of a person buried there, at so remote a period, that the moss had risen ten feet over it. Whether a human body had lain there or not, the cloth must have been so deposited; for the solidity of the moss over and round where it was found, prove that it had not been buried in a pit dug into the moss. The clothes found on human bodies, which had remained, some of them many centuries, buried in moss, have always been found to be no way impaired. I have in my custody, a piece of cloth nearly a yard square, found under about two feet of bent-moss, at Stoneyford, in the parish of Avondale, Lanarkshire. From the depth and quality of the moss, it is likely that it has remained there for many centuries. The fabric of the cloth evidently points to a remote period. It is not formed of wool, but of hair, the threads, which are ill spun, are thicker than those used in the coarsest Carpets, and the texture is thin and simple. The cloth, however, is not in the least injured by rotting. It seems however to have been a good deal worn before it was deposited in the moss, and in one place a rent has been sewed with a thread of nearly the same kind as that of which it is formed.

Not only wood and cloth, but even animal substances, which are still more susceptible of corruption, have frequently been found entire, after remaining buried under moss for several hundred years. The antiseptic qualities of peat-earth seem to exceed in their effects, even the art of embalming, practised by the ancient Egyptians. In Vol. XXXVIII. of the *Philosophical Transactions* for the year 1734, p. 413, mention is

made of two human bodies dug from under moss, where they had remained forty-nine years, and yet corruption had not made the smallest progress upon them. Their flesh was quite fair, and pitted when pressed with the finger; the joints played freely, without the least degree of stiffness, and their clothes were no way impaired.

In Vol. XLIV. of the same work, p. 571, for the year 1747, an account is given of the body of a woman, found under a moss in Lincolnshire, which, from the antique sandals found on her feet, had evidently remained many centuries under the moss; yet the body had suffered nothing by corruption. Her hair and nails were as fresh and free from putrefaction as those of any living person. Her skin was soft and strong, and stretched out like doe leather; but had acquired a tawny colour.

The Countess of Moira, in a letter published in Vol. VIIth. of the *Archæologia*, mentions that a human body was found under moss, *eleven feet deep*, on the Estate of her Noble husband. The body was completely clothed in garments made of hair, and which were fresh and no way impaired; and though the *hairy* vestments evidently point to a period extremely remote, before the introduction of sheep and the use of wool, yet the body and the clothes were no way impaired.

I know of several instances of dead bodies being dug up after having been more than a century buried under moss, and all of them were as free of putrefaction as they were when buried. I have seen some of them, and could point them out if necessary. But as the graves of some of these have been opened, and the *manes* of the dead too often, and by far too wantonly insulted, I forbear to mention names or point out places. The fact is sufficiently established.

It remains to be ascertained, what are the ingredients in Moss-plants, which enable them to withstand the powers of putrefaction on themselves and on all that is buried in moss. Some, to whose chemical knowledge I thought I could have trusted, have mentioned one thing, and some another, as the cause of this antiseptic quality. Dr. Walker says, it cannot be

ascribed, either to the mineral or vegetable acids. But Dr. Rennie ranks the *Carbonic acid*, the *Gallic acid*, and the *Sulphuric acid*, among the chief causes of that antiseptic quality in moss. Dr. Jamieson found acid in moss, which, he says, is similar to the *Suberic*, or acid of cork. Dr. Rennie imputes the inflammability of moss to its retaining, while under partial decomposition, a large portion of Hydrogen, and Dr. Jamieson says, many facts lead him to conclude, that the common peat is vegetable matter *deprived* of a considerable portion of its *Hydrogen*.

Where Doctors differ it would be presumptuous in me to offer to decide. There is one ingredient, however, which I am certain abounds in moss, and which I do not find any of the learned Doctors rank among its antiseptic qualities; but which, in my humble opinion, is the chief cause of that quality, namely *Tannin*. Many of the plants which grow upon and contribute to the formation of moss are well known to contain a considerable portion of *tan*. *Tormentilla Officinalis*, which is found in considerable quantities in all sorts of moss, contains a larger quantity of *tan* than is found in any other plant. I believe it is the most powerful astringent to be found in the vegetable kingdom. The quantity of it which grows in moss is sufficient to impregnate the mass of moss-earth with *Tannin*. Accordingly we find, that moss not only preserves leather, as it does other animal substances, from putrefaction; but it actually tans it as *well*, though not so *soon* as can be done in the ordinary process by oak-bark. If Resin, Gum, Extract, &c. be found in moss-plants, as I believe they are, they will probably contribute to its antiseptic quality.

SECT. III.

Of the Acidity of Moss.

THE smell of moss when newly dug, the pungent acrid odour of peat smoke, and smell of clothes, or any thing which has been kept in a house where peats are used as fuel; the pain in the eyes which is felt by those who are not accustomed to breathe in such an atmosphere, &c. all prove that moss abounds with acid. But the learned are not agreed what species of acid it is, that prevails in that substance. The conclusions of Dr. Rennie seem to be the most rational, and they are probably the most correct; namely, that though the acidity of all moss is apparent, it is not easy to discriminate the particular acid, and probably different acids abound in different mosses.

SECT. IV.

Of the Tenacity of Peat.

Degner, who first advanced the opinion, that was afterwards adopted by Dr. Anderson as to the origin of moss, endeavours to bring evidence in support of that opinion from moss, when dried into peat, becoming a hard tenacious substance, and, as he avers, insoluble in water. He says, that his countrymen, the Dutch, frequently lay the foundation of their houses with peat, and asserts that, when the houses have decayed through age, the peats remain sound. Dr. Anderson takes up the same argument for the same purpose, and Dr. Rennie has devoted a long Section to the description of this, as one of the qualities of moss. He notices that peat when once dried is impervious to water, and quotes authority to show, that peat remained three months in the boiler of a Steam Engine, and "though exposed to a heat greater than boiling water, it remained un-

"changed," and he enters on a string of arguments to establish and account for that opinion.

I am not a believer, however, in that piece of Dutch doctrine, even when embellished with the flaming rant of Dr. Anderson, and illustrated and attempted to be accounted for by the learned and ingenious reasoning of Dr. Rennie. The two former have in that, as in many other points, distorted fact and arguments to support a whim, the mere creature of their own fancy. Solid, unbroken moss is so close and adhesive, that it will keep water like a dish; so will solid clay. Dried moss becomes hard, so does clay. A peat of the best quality is not so pervious to moisture as a clod of clay is; but it will undoubtedly absorb moisture, which will loosen its texture, reduce its cohesion, and ultimately convert it into friable and inadhesive mould.

I have never seen peats dug out from the foundation of a house, nor kept for three months in water that was hotter than boiling; but I have seen peats of as good quality as any in Holland, and that had been as well dried as peats could be; yet when exposed to the weather for a year or two, or kept for a season in a damp place, not only become saturated to the centre with moisture; but their texture was loosened, their adhesion broken, and their inflammability greatly impaired. When exposed to the vicissitudes of the weather, the best peat that ever was cut, will, in the course of a few years, be reduced to loose friable earth, destitute of tenacity, and nearly void of inflammability. Every person who has seen peats prepared for fuel, knows that when any of them have been left on the field where they were laid to dry, even for one single winter, they were rendered so open, light, loose, and void of inflammability, that they could not be used for fuel. And in two or three years more they crumble into earth, and every form of peat is lost. The peats which are next the ground in the peat-stack, if the ground be not very dry, become damp and loose, and their inflammability much impaired. The ends of those exposed to the weather in the outside of the stack are loosened in their texture, and rendered of little value for fuel, even in

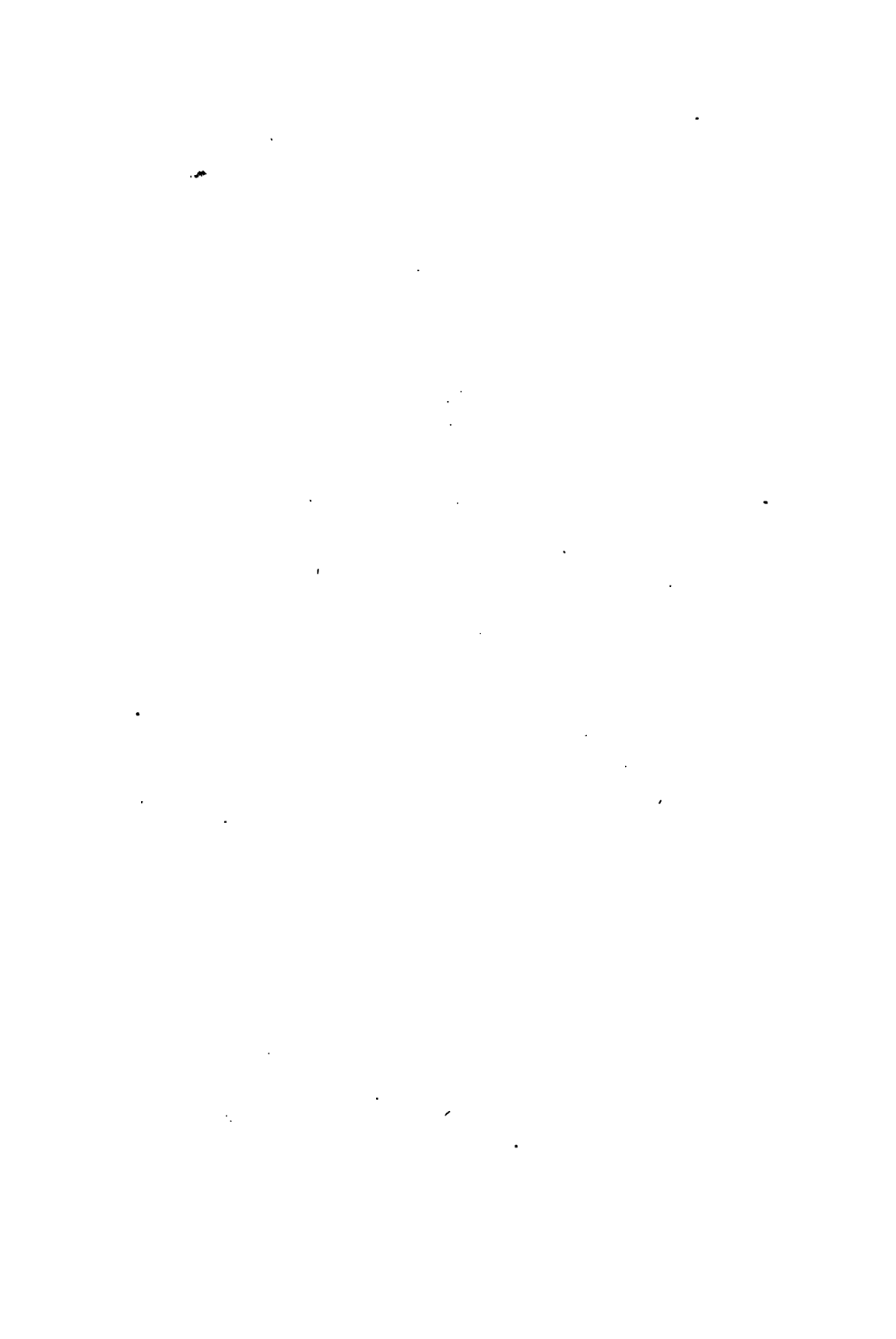
one winter : and if the stack stand for two years, putrefaction will have made such progress on the outer end of the peats, that vegetation will be seen growing on them. The whole stack itself would, in time, crumble down to earth. I do not advance this as reasoning *a priori*, founded on analogy, or authorities from foreign regions : I speak of what I have seen in hundreds of instances every year, for forty years past, and I appeal to every person that ever used peats as fuel, and to every peat moss and peat stack in Scotland, for evidence of the truth of what I say.

Degner and his disciple Dr. Anderson found another, and, with them, conclusive argument in support of their theory, in the circumstance that no living creatures are found in solid, uncultivated, steril, unbroken moss, termed by them *Quick moss* : and Dr. Rennie has become a proselyte to that opinion, and taking their story for his text, he has written a Section, in which he displays his ingenuity and scientific knowledge, to show that the want of worms proceeds from some peculiar quality in the moss.

I am still confidently of opinion, however, that the want of worms and reptiles in the unbroken moss does not proceed from any peculiar quality in the soil, the least inimical to animalcules ; but merely from there being no food in such earth to support these creatures. Worms feed upon vegetable matter that is under putrefaction, and wherever such abounds there will worms be found, and the moles, which live on the worms, will immediately follow. If there is no vegetable matter in a state of fermentation and decomposition in the soil, worms will not be found in it. There is no such matter in steril moss which has never been mixed with any other soil, or broken up, and on which no rich herbage rises. There is just as little on some pieces of cold barren adhesive clay in high situations, and which has never been dug up or manured : and worms will not be found in the one more than in the other. But let the moss or the clay be only broken up, relieved of moisture, dug, pulverized, and get the smallest quantity of any kind of manure, so as to bring some part of the vegetable matter into putridity, then one may

depend on finding there legions of worms, and troops of moles in pursuit of them.

The opinion of Degner has struck Dr Rennie so forcibly, and his own scientific arguments in support of the doctrine, have been so conclusive, that he avers that no species of fish exists in liquid moss or moss water. But in making due inquiry, he will find he has been misled on the subject. There are hundreds of burns, strands, and small lakes in all parts of Scotland, which are situated in the middle of extensive and deep mosses, and into which nothing but dark coloured moss-water enters or can enter, and yet these lochs, stanks, and streams *abound with fish*. The Black-burn, in the parish of Crawford-john, Lanarkshire, rises in and runs through mosses of the deepest and most barren kind ; nothing falls into it, or ever fell, or can fall into it, but moss-water, generally of as dark a colour as porter, and there is scarcely a cultivated acre in its course ; yet that burn is well known to produce the largest, the best, and the greatest number of trouts which are to be met with in any stream of the same size in Scotland.



PART III.

OF THE

USES TO WHICH

MOSS-EARTH

CAN BE CONVERTED.

THE uses to which moss-earth is capable of being converted, becomes the most important inquiry concerning that substance. The origin of moss, or the qualities that it possesses, are only interesting, in so far as they lead to a discovery of the uses to which it may be applied. The purposes to which moss-earth has chiefly been converted are, *Fuel, Manure, Pasture* without cultivation, and a *cultivated soil*. On each of these a few remarks will be offered.

CHAP. I.

OF MOSS AS A SPECIES OF FUEL.

THE utility of moss as a species of fuel is so universally known and so well understood as to render much discussion on the subject unnecessary. Wherever coal abounds, moss is of little value as fuel, but in all parts where coal is distant, or difficult to be obtained, next to wood moss is the best substitute. The quality of peats and the mode of cutting, drying, and storing them, are so well known to all ranks, that a few remarks on each may suffice.

SECT. I.

Of the quality of Peat.

INFLAMMABILITY and durability are the qualities which enhance the value of every species of fuel. Moss-earth, of all kinds, is more inflammable than coal, and equally inflammable with wood. In durability the best of peat is scarcely equal to wood, and far from being equal to coal.

Some moss makes a much more durable fuel than others. That which is formed under the greatest degree of moisture, and on which putrefaction has made least progress, makes always the weakest and least durable fuel; and that which is accumulated under least moisture, and is most decomposed, makes the most powerful and lasting fuel. When the moss stratum has, from top to bottom, been collected under nearly an equal degree of humidity, that which is nearest the surface makes the worst, and that towards the bottom the best fuel;

but as the surface has, during the formation of the moss, frequently undergone considerable changes in point of humidity, corresponding changes have been thereby made on the herbage, and of course on the quantity of the moss-earth that has been formed from that herbage. Hence we find in all deep mosses, when a section is laid open, frequent mixtures of darker and lighter coloured mosses, or, in other words, of good and bad fuel. The light, whitish-coloured, open fibrous moss-earth, formed from the *Sphagnum Palustre*, *Bryum Hypnoides*, and other plants which grow in the wettest mosses, makes a weak fuel, and that has little durability. It kindles like tow, and blazes for a time, but has neither much heat nor continuation. The moss that is most firm and solid, of the blackest colour, most weighty, is most dissolved by putrefaction, has least of the vegetable texture remaining, and which has a vivid saponaceous appearance, makes the strongest fire, and is by far the most durable.

In a note added to page 27th, Mr. Naismith thinks the want of cohesion in certain mosses is owing to the want of the *Bryum Hypnoides* and *Lichen Rangiferanus* in these mosses. It does not appear to me that either of these plants contributes to the cohesion of moss, but greatly the reverse, especially the former. The *Bryum Hypnoides* is that drab-coloured, bulkiest of all the moss plants, that rises in cohesion or knolls, like small cocks of hay in all deep level flow mosses. When growing, it is as open as a rick of hay newly formed, the plants are of considerable size for moss plants, and the moss-earth formed from them is more open and incohesive, than that formed from any other plants, except it be the *Sphagnum Palustre*. Perhaps the *Lichen Rangiferanus* may more readily dissolve and contribute to the formation of the viscid glutinous moss than that which is more fibrous; but the plant is so extremely small, that its effects can scarcely be at all perceptible in the moss strata. It is that white brittle *Lichen* which grows among the roots of heather, and resembles that found on the decaying thorns of old neglected hedges.

The cohesion of moss-earth, and its strength and durability

as a fuel, proceed from the more complete decay and decomposition of the plants from which the moss has been formed; and that decay is in proportion to the dryness of the surface when under decay. When putrefaction has made but little progress in the dissolution of the moss plants, they form an open, light, fibrous, turfy peat. But when much of the fibre is reduced into a mucous viscid substance, the fuel is strong and durable. Bent-moss always makes better fuel than flow-moss. Not because the *Bryum* or *Lichen* abounds in these, for neither of them is often met with in bent-moss, but from the growth of many of the best grasses, such as the sweet scented vernal (*Anthoxanthum Odoratum*) *Holcus Lanatus*, several of the *Agrostes*, *Festuca*, and such like; the whole plants being more disposed to yield to putrefaction, than the same plants would be if they had grown in a more humid soil. In bent moss, the strong fibrous roots of the *Milica Cerulea*, *Nardus Striæti*, and other plants growing on the surface, sink deep into the moss-earth, and being strong and closely netted together, they bind the viscid glutinous matter in the moss, and render the peat of it firm and adhesive. In all moss-earth there are a few inches next the subsoil, that is more viscid and saponaceous, and of course makes better fuel than any other part of the stratum. This is partly owing to the age of that part of the moss; but still more to the herbage from which it has been formed. The greater proportion of rich plants that grow on the moss, the better and more durable will be the peat. When the moss plants were first introduced over the original soil, many of the former grasses would rise for a time, and the moss-plants would only come in gradually. So long as any of these continued to grow among the moss-plants they would fall more completely under putrefaction than the other, and fall into that mucous viscid moss, that is found next the clay, and forms peat nearly as hard and weighty as coal, and which burns with as much heat, and lasts nearly as long as some coal.

S E C T. II.

Of Cutting, Drying, and preserving Peat.

IN a part of the country abounding with fuel, no regard need be paid to the mode of cutting peat, save to select that of the best quality, and obtain good fuel, with least labour. Frequently, however, the quality of the peat is much injured by slovenly treatment. Many continue to dig their peats from the same places, and in the same way which they and their predecessors had done, whether that may have been the most improved method or the reverse. They would grudge to search for, and lay open a field of better peat. They carry on the section, or the *bink* as they term it, of a convenient depth for easier cutting, frequently using the moss of least value above, and leaving that which is of much greater value. They generally have their spread-field in the most slovenly state, often so uneven that a few hours of rain, or even a heavy shower, will lay the half of the field, with the peats, under water. They are at no pains to form the field so as to relieve it of stagnant water; and the best peats are often much injured by being laid on such a field. No cart can reach them till an extreme drought exhale the pool of water, and dry the field.

Where fuel of every kind abounds, the turf or sward on the surface, which is generally thrown to the bottom of the pit, where it remains a kind of unswarded mire, should be dried and burnt, the moss cut up to clay, and the ground cultivated. But instead of this, the best peat is left below, the turf thrown over it, and the whole formed into a stank, where no herbage grows for many years; where the peats are rendered of little use, if the weather is not extremely dry; and where neither man nor animal can go, but in times of frost or great drought.

Where moss too much abounds, the ground should be cleared of it as the peat field advances. But where it and other

kinds of fuel are scarce, the utmost pains should be taken to lay the turf with the green side up, keep the ground so moist as to accelerate the growth of the moss-plants, so that a new course of peat may be obtained as soon as possible. The mode of cutting the peat, laying it out to dry, and setting it on end, as soon as it can bear its own weight, are operations to which I can propose no improvement.

In Holland, Ireland, and some parts of Galloway, where moss is not abundant, the inhabitants collect the mud, or sludge, to be found in stanks, lay it in heaps on the grass, water it, knead and bake it into a paste, after the manner that lime is prepared for plaster, and afterwards cut it into peat. When properly kneaded, this forms the best of fuel. The peat is so much improved by that mode of preparation, as fully to compensate the additional labour. Peat that is to be used in drying corn, or such like purposes, would be greatly improved by being prepared in this way.

The ingenious and patriotic Patrick Miller of Dalswinton, Esq. discovered a mode of making artificial peat, by baking up moss-mud, with coal-culm, saw-dust, tanner's bark, cow's-dung, or any other inflammable matter, mixed with a portion of clay. This has been found to make an excellent fuel. The clay adds much to its durability, and renders the ashes of great value as a manure. This kind of peat merits attention where fuel is scarce.

The greatest improvement in the management of peats would be, to erect sheds to screen them from the rains, after they are brought home. By the present economy, the peats are put up into a stack, near the houses, which, like the dung-hill, is exposed to the whole force of the winter rains, frost, and every vicissitude of the weather. Placed in such a situation the peats are never dry, but in time of drought, the outside of the peat-stack is wetted and dried many hundreds of times in the course of the year; till the cohesion and inflammability of the peats are impaired, and they are reduced almost to earth. The one end of the stack is kept open, and the peats are carried from it to the fire, by the girls, in their aprons, or in a

small basket, ten, or perhaps twenty times in a day, and if the weather be rainy, the whole peats used are soaked in water. The smoke they emit, when in that state, fills the house so closely, that the inmates can scarcely see each other, or the furniture. The stench of the smoke is insufferable, and extremely acrid; and it is with difficulty the family can cook their victuals with such fuel. The peats do not burn but singe.

All these evils might easily be remedied, the fuel improved, saved from waste, and the labours of the kitchen facilitated, by erecting sheds to cover the peats from the rain. The roofing of an old house, or cupples made of wood, of the least value, set on pillars of stone, or on a wall built without mortar, through which a current of air could pass, and thatched with heath, broom, fern, or rushes, with turf, might be fitted up of size to hold one year's peats, at an expence which its use for a single year would amply compensate. Such a shed, besides preserving and improving the peat, rendering the family much more comfortable, and facilitating their kitchen work, would soon repay the expence in saving of labour. The best workman about the farm house, is generally employed ten or twelve days every year *building* the peat stack, and another in handing up the peats. All that labour might be saved by the shed, into which the peats could be *thrown* without *building*. The peats might, in that case, be brought home, though only half dry, as the current of air passing through the shed among them, when *thrown* in loosely, would soon render them sufficiently dry, and prevent them from being injured by the weather. Peats are generally used in drying corn for the mill. But when these are wet, they give a bad taste and disagreeable smell to the grain.

It is really surprising how careless the farmers are in this matter. Most of them could erect a peat shed, of wood which is suffered to rot, in the time they lose every year in curling, loitering about mills or smith's shops, or sauntering at markets, rousps, races, &c. when they have no necessary business. But when people have been long accustomed to slovenly

habits; and no proper example set them by their neighbours, they trudge on in the old path, satisfied with the degree of comfort and conveniency they and their fathers have been in use to enjoy.

I have frequently pointed out the advantage of peat sheds to those who burn that description of fuel. All admit they would be an advantage, but few have begun to fit them up. Tenants are afraid to erect them, lest their successors in the farms should reap the benefit; and the Bonnet Lairds are too indolent to fit them up. One man told me, he had arrived at such dexterity in building his peat stack neatly, that he should never suffer it to be covered from the eyes of any who came to his house.

CHAP. II.

OF MOSS AS A SPECIES OF MANURE.

SECT. I.

Preliminary Remarks.

VEGETABLES, like animals, subsist on certain substances which constitute their food. If these are supplied of proper quality, and in due proportion, the plants will thrive and attain the utmost perfection of their nature; but if the food is not suited to their taste, or is too scantily supplied, the plants will either die or become dwarfish and unhealthy.

Plants, like animals, delight in a variety of food. No animal could attain perfection, or live comfortably, on any one kind of food. Plants manifest an equal inclination for variety of aliment. Nature, the bountiful provider of all her offspring, furnishes abundance of food for their tables, as well as for those of animals. All the kingdoms of nature are laid under

contribution for a supply of food to the vegetable kingdom. Minerals, and vegetables themselves all contribute to the food of plants. Water, light, heat, gaseous substances, as Hydrogen, Azote, Carbon, &c. in various states of combination, have all been appointed by nature to contribute to the food of plants.

The operations of nature in providing and administering to the food of plants, require to be aided and regulated by rational industry. Man, the keeper of the great garden of nature, is endowed with reason to enable him to pry into her laws, and to direct and assist in her operations. Nature requires assistance, but will not bear to be contradicted.—Whoever studies the laws of nature, and administers assistance, in conformity to them, will prosper; but all who attempt to thwart nature, and turn her out of her own course, will meet with the disappointment such presumption deserves.

Human industry ought to be exerted in curing every defect in the soil. If it be too dry, too wet, too soft, or too adhesive, or if it want a due proportion of any of the primitive earths, these ought to be supplied, till the soil be formed of proper materials, and its mechanical arrangement corrected. If the soil want a due proportion of vegetable matter, that ought to be supplied by industry; or if the vegetable matter in the soil have become insoluble, and remain stationary and inactive, some stimulating substance ought to be applied to bring the dormant substance into action.

These various applications, in which so much room is left for human sagacity and industry, are termed *Manures*. The proper application of these forms an important branch of Husbandry.

Every substance that either goes spontaneously into putrefaction, or can be forced to undergo a decomposition of parts, will operate as a manure to the soil, or in other words will, while undergoing these changes, yield food to growing vegetables. The mineral kingdom, though probably composed of the same elementary matter as the vegetable and animal, by being formed of different proportions, united by more powerful attractions, or held together by stronger affinities, is not

subjected to spontaneous decomposition, or separation of parts. The primary matter of which they were originally formed, remains connected, and their organic texture unimpaired. Of course they can yield nothing to the support of vegetable or animal life. The pure earth stands much in the same situation as the minerals. Sand and clay are composed of the same materials as the minerals, and they are nearly as indestructible; they form a matrix for the germination and growth of plants, but where no separation of their parts goes on, plants can derive no food from them. When the soil is formed of a proper mixture of the primitive earths blended with animal and vegetable matter, it becomes productive, and yields food to plants. But it is not the pure sand or clay which yields that food; it is the vegetable substances and other matter on which corruption acts, and the amplitude of that food will be in exact proportion to the extent of decomposition of bodies or change of matter in the soil.

It is not the matter but the annihilation of that matter that supports vegetation, or acts as manure. If animal and vegetable bodies remained in the soil undissolved like minerals or the primitive earths, vegetables would derive as little from the one as from the other. And if the elementary matter in the minerals, and in the soil, were set at liberty, by a complete reduction of the organic texture of some part of the rocks, the particles of sand, or of clay, either spontaneously, or by artificial means, I have no doubt but plants would be able to gather their food from that change, as well as from the reduction of the organic texture of vegetables and animals. But though the mineral kingdom is not subjected to the power of spontaneous corruption, the vegetable and animal kingdoms of nature are subjected to that destroyer. It is the decomposition of the latter that properly comes into view in this place.

Vegetables as well as animals, whenever they are deprived of the vital principle, fall under the powers of putrefaction. That irresistible destroyer of animal and vegetable matter begins whenever life ends, and steadily pursues his course, till the subject on which he acts is totally decomposed; the beauti-

ful work of vegetable organization is annihilated, and all the substances of which the plants were composed are separated, and either restored to the elements from which they were collected, or enter into new combinations.

The effluvia thrown off by animal matter under putrefaction, are noxious and generally fatal to animal life. But those which are thrown off by one crop of plants under putrefaction, form the very life and food of growing vegetables. The fact is well known, though many things in this mysterious branch of the economy of nature remain to be ascertained. They are no doubt greatly varied by the quantity of the vegetables under decomposition, as well as by other relative circumstances. Plants abounding in mucilage, and of a juicy luxuriance, will yield more readily to putrefaction than those that are more fibrous, dry, and wiry; and if due quantities of heat, air and moisture are supplied, the process will proceed more rapidly than when these are withheld.

It has already been shown, that the plants which contribute to the formation of moss-earth, from the low temperature and degree of moisture in which they grow, or from the loose qualities of the plants, abound with acid, tannin, extract, and other ingredients that retard the progress of putrefaction, and prevent that powerful destroyer from reducing completely their original texture. It has been shown, that it is owing to these insoluble qualities in moss-plants, and the want of richer and more succulent ingredients, that moss-earth has ever been formed over the original soil.

It is these very qualities that prevent moss-earth from spontaneously becoming manure, the same as hay, straw, grass, or any other vegetable. Moss is wholly composed of vegetable matter, the successive crops of plants that have grown on the surface; and if that matter did not possess qualities different from those which form other vegetables, it would be as good manure as they are. Could moss-earth be only divested of its insoluble qualities, the whole moor would form so many immense dung-hills.

But what nature hath not accomplished, may, at least in part,

be effected by the ingenuity and industry of man. Moss-earth is no doubt insoluble, but if that insolubility can be overcome by art, the end in view will be attained. The proper investigation can only be made by those who are conversant in science. My knowledge in Chemistry is too imperfect to enable me to make correct experiments, nor have I had leisure even to make the attempt. The subject, however, has fallen under the investigation of others much better qualified to do it justice, and I trust, means will soon be discovered of reducing the antiseptic qualities of moss-earth, and thereby setting at liberty the immense masses of vegetable food, which now lie dormant in that species of earth. The inquiry is of high importance, and as many of the most eminent Chemists are begun to pay that attention which it so justly merits, more important discoveries may soon be expected. I know no discovery of the last century of nearly so much consequence. Could that great end be accomplished at a moderate expence, the fertility of the soil, all over Scotland, would exceed our most sanguine wishes. The deserts would become fruitful fields, in the utmost sense of the term, and subsistence might be raised in our native country for four times the present number of its inhabitants. Till further discoveries are made, it is proper to attend to what is already known and practised on that subject. Moss-earth has been used as a manure with success, without any admixture or proportion whatever; it has been rendered in some measure soluble by being mixed with lime, and this has been more completely effected by bringing it into fermentation with dung and other fermenting substances.

SECT. II.

Of Moss alone as a Manure.

Moss-EARTH will, without any preparation whatever, operate as a manure to any other soils in the same way that one

steril earth tends to enrich another. Moss-earth will help to mend the mechanical arrangement of any of the other soils, which is frequently their greatest defect. The extreme cohesiveness of clay is often a bar to its improvement. Pure sand is unproductive from a contrary cause. If these are mixed with each other, or if moss-earth is mixed with either, they will be cured of these defects. The tenacious clay will be rendered more open, the moisture will more easily percolate, a greater scope will be given to the roots of plants, the clay will not be so retentive of moisture in wet weather, nor so adhesive when dry.

A mixture of moss among sand would deepen the soil, render it more retentive of moisture, and prevent the crop from being so readily injured by the drought.

If the clay lay in an elevated situation, and was extremely steril and moist, moss-earth in its natural state would only form a mixture as soil, but the heat and fermentation under such circumstances would not be sufficient to accelerate the decomposition of the moss-earth. But if mixed with a sandy or gravelly soil, in a low situation, the moss-earth would have more powerful effects. It would not only mend the mechanical arrangement of the soil, but the heat of the sand, and more free access of air, would greatly accelerate the putrefaction and decomposition of the moss-earth; and as putrefaction proceeded, the food of vegetation would be supplied. But it is much better to bring the moss into a course of putridity by some fermenting admixture before it is applied to any soil. If no such mixture can be procured, let the moss-earth be thrown up in heaps, first exposed to the frost, and then to the other changes of weather for a year or two; and if it is turned over, some sand or clay mixed with it, and the whole exposed for two seasons to the weather it will form a tolerable manure. But in an age so enlightened as the present, it might well be expected that some more powerful dissolvent of moss-earth might be discovered.

SECT. III.

Of Moss formed into manure by being mixed with Lime.

MOSS-EARTH may be formed into an excellent manure by being mixed with hot and newly slacked lime, and laid up in a midden or heap for a few months, and turned over once or twice before being applied to the soil. Moss has long ago been prepared into manure with lime, and it still continues to be so prepared and used.

The best way to prepare it with lime is to dig up the moss, and throw it in heaps after harvest or early in winter, so that the frost may operate on the moss, and in part reduce its texture, before the drought forms it into a peat. When dug up and exposed to summer drought before the frost has loosened its adhesiveness, it becomes a real peat, and will not again so easily melt down by the weather. But if it is exposed first to frost, the alternate changes of weather will soon reduce it from peat to earth; the drought after the frost will not form it into peat, but with the other changes of weather it will aid in reducing the organic texture of the moss.

After being exposed to the weather for a whole winter, the moss-earth may be removed in the spring to the field to which it is intended to be applied, and when it is between wet and dry, thrown up into a convenient midden, and mixed with about a fifth or sixth part of its weight of hot newly slacked lime in a powdery state. The moss should be as much broken as possible, and minutely mixed with the lime. The direction given by the Earl of Dundonald, in his valuable Treatise, showing the connection between Chemistry and Agriculture, (p. 109) is so much in point, that I cannot better convey my ideas on the subject, than in the words of that worthy and learned Nobleman.

“ The only substance of a caustic nature, and capable of de-

“stroying the organic texture of vegetable bodies which in
 “some places has been used, is lime, though not in so judicious
 “a manner as to ensure, at all times, uniformly good effects
 “from its application, which can never be depended upon if
 “the proportions of each substance, and the particular state of
 “them, are unattended to and neglected, as will appear by the
 “following observations.

“When hot, or newly calcined lime is broken into pieces
 “of a small size, and mixed with peat, moderately humid, heat
 “is disengaged, and that heat by the slacking of the lime,
 “when it is applied in too great a proportion, is so increased,
 “as completely to reduce the peat to charcoal, and to dissipate
 “in a gaseous state, all its component parts, excepting the ash-
 “es, part of the carbonaceous matter, and such a portion of
 “fixable air, generated in the process, as is absorbed by the
 “lime, by which that substance is made to return to the state
 “of chalk. No benefit can therefore arise by this method of
 “preparing peat with lime, the object not being to destroy and
 “dissipate, in a gaseous state, the component parts of the peat;
 “but to make such a combination with the lime, and the gas
 “generated in the process, as will, on the application of the
 “mixture to the soil, promote the growth of plants.

“This object is best attained by mixing newly made, and
 “completely slacked lime, with about five or six times its
 “weight of peat, which should be moderately humid, and not
 “in a too dry state. In this case the heat generated will be mode-
 “rate, and never sufficient to convert the peat into carbonaceous
 “matter, or to throw off, in the state of fixable air, the acids
 “therein contained. The gases thus generated, will be in-
 “flammable and phlogisticated air, forming volatile alkali,
 “which will combine, as it is formed, with the oxygenated part
 “of the peat that remains unacted upon by the lime, applied
 “for this especial purpose, in a small proportion. By this
 “mode of conducting the process, a soluble saline matter will be
 “procured, consisting of phosphat and oxalat of ammoniac,
 “whose beneficial effects on vegetation have already been de-
 “scribed.

" Inattention or ignorance of these important facts, has
 " probably, in many cases, defeated the wishes of the farmer
 " in the application of this preparation, which is particularly
 " recommended as a top-dressing to the grounds under pas-
 " ture. The proportion of lime to the peat here given, should be
 " carefully attended to; and the mixing of the two substances
 " together, should be performed under cover, in a shed or out-
 " house constructed for that purpose, as too much rain, or a
 " too great exposure to air, will prevent a due action of the
 " lime upon the peat. The success of most operations, but
 " more especially of those of a chemical nature, greatly de-
 " pends upon a regular and due observance of circumstances
 " apparently trivial.

" This preparation of lime and peat, is in a peculiar manner
 " conducive to the growth of clover, and of the short, and, as
 " they are called, sweet kinds of pasture grasses. The soil
 " also, by the application of it, acquires such a predisposing
 " tendency to promote the growth of such grasses, as to pre-
 " vent its growing afterwards rank, coarse, or sour herbage."

The compost of moss-earth thus made up with lime, ought
 to remain several months in that state; after which, it ought
 to be turned over, well mixed and broken; some fresh lime,
 and if possible, a small quantity of earth, or even some little
 dung applied, and having remained a few months more in the
 midden, it may be used as manure, either as a top-dressing or
 otherwise. It should remain a year at least in the midden
 with the lime; but the longer it remains in that state, the of-
 tener it is turned over, and the more lime, earth, dung, or
 other admixtures that are applied, the richer will be the man-
 ure. Wherever green herbage of any kind can be obtained,
 it ought to be mixed into the midden when turned over.

But the utility of moss-earth mixed with lime for manure
 has been doubted by some who, I would have supposed, were
 well qualified to judge of its value. A learned Senator, of the
 College of Justice, Lord Meadowbank, whose researches into
 Chemistry and Agriculture have been unremitting, in an Essay
 published in the Second Vol. of the transactions of the Highland

Society, page 150, says, "Peat prepared with lime alone has not been found to answer as a good manure. In one instance, viz. In a bit of fallow sown with wheat, it was evidently pernicious."

Dr. Walker, in the Essay formerly mentioned, seems to doubt of the utility of moss as a manure, when prepared with lime. He says, (page 55,) "when lime or any other calcareous manures are intermixed with peat, they may, by encountering the acid in the peat, occasion effervescence, by which the substance of the peat may be more minutely divided, and impregnated with neutralized and fertilizing matter. But these manures, though capable of effervescence, are themselves incapable of putrefaction, or of communicating that process to peat, or any other substance that is not susceptible of it. Accordingly peat-earth and lime, both in its mild and caustic state, were mixed in various proportions; some of these mixtures were exposed to the air for one, and others for two years, yet no degree of putrefaction on the earth could be discerned; for though peat consists chiefly of vegetable matter, yet it is in such a state as to resist the septic powers of lime."

When men so eminent in science and so much conversant in agriculture, as the Learned Judge and respectable Professor, have already decided, it may appear presumptuous in me, confessedly ignorant of Chemistry, to offer my opinion. But with all deference to the memory of the one, and high respect I entertain for the other, I am bound to say that both of them seem to me to have mistaken the effects of lime and moss-earth as a manure. That it may fail in some instances cannot be doubted. The cause of failure in the instance recorded by his Lordship, I shall not attempt to explain. But that it has been used with effect in many hundreds of instances that I have seen and known, both before and since I published on that subject, and that it still continues to be so used by many who have had long experience of its effects as a manure, are facts which I know, and can well attest. Having seen the opinions of these respectable and intelligent authors on that

subject, I have, in the course of my extensive peregrination, in Scotland and England, made particular inquiry into that matter, and I find that moss-earth prepared with lime alone, has been used, and continues to be used as a manure, with success, in many parts of both kingdoms. I would be cautious of receiving the stories of country people, in contradiction to well known principles of science. But in a matter of this kind, I am disposed to give credit to the well attested facts of many who have made the experiment, though some men of extensive erudition, may think these experiments inconsistent with some of the general principles of science.

The learned Lord does not say, that he conceives it contrary to science, for moss mixed with lime, to operate as a manure. He says, he did not find it a good manure, and in one instance, it proved injurious; that might proceed from some peculiarity in the quality of the moss which his Lordship then used, from something in the soil, or state of the land to which it was applied, or in the mode of preparation, or some other relative circumstance. The experiments made by many others with great success, shew, that the failure of his Lordship's manure, must have proceeded from some local or relative circumstance, though the particular cause has not been discovered.

Dr. Walker, indeed, opposes both theory and practice to the use of moss prepared with lime for manure: but it remains to be inquired into, whether he is correct in his theories and experiments; he admits in the passage quoted, that when peat is mixed with lime, the calcareous matter encounters the acid in the peat, occasions effervescence, which divides the substance of the peat, and impregnates it with neutralized and fertilizing matter. Here the Professor not only admits the very fact I wish to establish, but explains the scientific process by which moss, mixed with lime, is formed into manure; but then, he adds, that this species of manure is incapable of putrefaction, or of communicating that process to *subjects incapable of fermentation*, and says, moss is in such a state, as to resist the septic powers of lime; if so, it can do no good as manure, for

it is only as putrefaction advances, that the food of plants is formed, or set at liberty, from dead vegetable matter.

It may seem arrogant in one, whose knowledge of science is still so imperfect, to presume to argue with the Professor of Natural History on chemical subjects : but it does not seem to require correct scientific knowledge, to account for the effects of hot lime on vegetable matter. Every man who has paid the least attention to the powers and effects of caustic lime when applied as a manure, must have learnt, that it and all other calcareous manures, being themselves void of fertilizing matter, only promote vegetation by the effects they produce on the vegetable matter already in the soil ; it is in the same way it takes effect on moss. The calcareous matter in the hot lime, engages the acid in the peat, brings on heat and fermentation, and thereby generates a neutralized matter, which greatly promotes vegetation : the fermentation, or effervescence, brought on by the calcareous matter, encountering the acids in the peat-earth, not only forms a fertilizing saline matter, which powerfully advances vegetation, but it also renders it soluble, while at the same time, it rapidly breaks the fibre and texture of the moss, divides it minutely, and thereby reduces it to a manure. Even Dr. Walker himself admits the powers of calcareous earths, in promoting putrefaction of vegetable substances ; he says, (Essay, page 24,) " calcareous earth is well known to promote " the putrefaction of vegetable and animal substances. The " Island of Lismore is, for the most part, composed of lime- " stone ; all its mosses are much intermixed with calcareous " earth ; they are therefore most putrid, and most consumed " of any that are to be seen." The same effects will follow every where, and if moss be rendered sufficiently putrid, it will prove the best of manure.

That caustic lime will operate upon moss, in every state in which we find it, is evident from the effects it has upon other soil. When land has been often manured with dung, part of the vegetable matter, both of the dung, and that in the soil, becomes insoluble, and yields no food for vegetation. Hence we often find abundance of vegetable matter in the soil re-

duced entirely to earth; yet so insoluble, as to be of no manner of use to vegetation. What is the remedy in this case? hot lime most undoubtedly. The caustic lime, when applied to land in that state, reduces the insolubility of the vegetable substance, and forces its dormant powers into action. In this case, the putrefaction of the vegetable matter has proceeded much further than it has done on moss. Nothing of the vegetable fibre, or texture of the plant remains, nor is even a black unmixed earth to be found there as in moss. Nothing remains of the vegetable substance, that is perceptible to the eye; yet enough will be found of the insoluble vegetable matter, for the caustic lime to act upon. And such are the powers of hot lime, in reducing even these imperceptible remains of vegetable substance, that the most luxuriant crops of grain are always produced, when hot lime is applied to such a soil. It would be strange indeed, if lime in a caustic state, had such powerful effects on vegetable matter so far advanced in putrefaction, and yet had no such powers upon moss where putrefaction has not made such progress: if it were admitted that hot lime had no such effects on moss, the reason must be very different from that assigned by Dr. Walker. But fortunately for mankind, he is not correct in that opinion.

Besides the Earl of Dundonald, I might also have quoted on this subject Dr. Garnet and others, the best qualified to judge on scientific principles. The intelligent Mr. Nasmith (page 43) says "We know in general, that it is the property of quick lime to decompose moist vegetable substances, and I am certain from experience, that one part of lime newly slacked into a mild powder, mixed with five or six parts of moist peat, and the whole repeatedly turned and broken before the lime becomes affected, falls into a fine friable mould, and that this mould, applied to any other soil, greatly promotes fertility."

I might have noticed the error into which Dr. Walker has fallen, in admitting, as he does, the powers of lime to neutralize the acid in moss, and minutely divide its parts, and yet doubting its powers of promoting putrefaction even when ex-

posed to the open air, for one or two years. I can say, that I never saw moss-earth taken from the common mass, and laid out and exposed to the open air for two years, even when no admixture whatever was applied, but I found putrefaction had made considerable advances. When lime, or any caustic substance which acts powerfully in dissolving moist vegetable matter, is applied, the progress of putrefaction must be greatly accelerated. The acid is one of the ingredients in moss that impedes its putrefaction. Every man that knows any thing of Chemistry, knows that the lime destroys that acidity, and forms with it a neutral salt. This is not only in itself fertilizing, but the removal of it lays the moss-earth open to putrefaction. The Doctor admits, that the effervescence of alkali and acid breaks, and minutely divides the moss-earth. If so, it must form it into manure. The lime destroys the antiseptic quality of the moss-earth, and forms of it the food of vegetation. It breaks and divides the organic texture of the vegetable matter, renders it soluble, sets putrefaction to work, and as it proceeds the moss is formed into manure.

Though I cannot help being diffident when I differ from Gentlemen so eminently qualified to judge, and would wish to treat their opinions with due respect, yet in the present case I am fully satisfied in my own mind, that moss-earth in general may be converted into efficient manure by an admixture of lime. That opinion is founded upon the little knowledge I possess of science ; it is corroborated and strengthened by the concurring opinion of others more conversant in science than I can pretend to be ; and it is confirmed by an experience of more than thirty years, under my own observation, as well as that of hundreds of others whom I could point out, who have for several years past used it with such success as to induce them to continue the practice, and convince them, from well tried experience, that moss mixed with lime is highly beneficial as manure.

S E C T. IV.

Of Moss formed into manure by being fermented with dung.

OF all the methods that have yet been discovered of converting moss-earth into manure, that of mixing and fermenting it with fresh dung is by far the most proper. The dung when in a proper stage of fermentation, and mixed with the moss in proper quantities, communicates its fermenting and putrefying qualities to the moss-earth, creates a heat which dissolves the acid in that earth, reduces its antiseptic qualities, and subjects it to a course of putrefaction, which ultimately dissolves its organic texture, sets at liberty the vegetable matter, or other substances of which the moss-earth was composed, and converts its whole substance into the food of vegetables.

Moss-earth had been by some farmers mixed with dung, and applied as a manure, before the middle of the last century. I have seen it so used by different people upwards of forty years ago. But those who did so had discovered no rule to guide their operations in preparing or using that species of manure; but proceeded at mere random, as many still do in preparing compost.

Lord Meadowbank was the first who investigated that species of manure on scientific principles, and after repeated experiments, placed it on a proper footing which can now be relied on. It had occurred to his Lordship, that by exciting heat and fermentation in the moss-earth, its insoluble qualities would be reduced, and that being once accomplished, the whole mass of moss-earth would then become as susceptible of putrefaction as any other vegetable matter. After many experiments, during the course of six years, his Lordship found that a mixture of dung with the moss-earth, in the form of a compost midden, brought the whole heap into heat; the fermenting and putrefying qualities of the dung were thereby communicated to the moss; its antiseptic qualities reduced, and the whole rendered

as soluble as any other heap of vegetable matter. Having made these discoveries, and repeated the experiments for the course of six years, his Lordship, with his usual patriotism and public spirit, communicated to the public, in a pamphlet which he distributed gratis, the discovery he had made.

In that pamphlet, the learned Judge gives a plain and concise account of the process of putrefaction of vegetables, and makes some judicious remarks on the propriety of preserving the richest qualities of dung, too often lost through misconduct. The essay is written in so plain and familiar a style, that the simplest mechanic may easily understand its import; and every farmer ought to know, and attend to the directions it contains.

After mentioning something of the nature and antiseptic qualities of moss, his Lordship remarks: "In general, however, there is nothing in the situation of peat-moss, or in the changes it has undergone, that leads to think that it has suffered any thing that unfits it to be prepared for manure. It is no doubt found sometimes mixed with particular mineral substances, that may be for a time pernicious to vegetation; but, in general, there is no such admixture; and when it does take place, a little patience and attention will be sufficient to cure the evil. In the ordinary case, the only substances found in peat that may be unfavourable to vegetation, in so far at least as tending to keep it stationary and prevent its rotting, are two, and both abounding in fresh vegetables, of the sorts of which moss is chiefly composed: these are gallic acid, or some other very like it, and the astringent principles of tan; and as these are got the better of in fresh vegetables by the hot fermentation to which they are subject, so as to leave the general mass of the substances to which they belonged properly prepared manure, there is no reason to suppose, that the same may not be accomplished with the acid and tan of peat. Again, the powers of peat as a fuel, and of ashes of peat as a manure, ought to convince every person, that the material and more

" essential parts of the dead vegetable, for the formation of
 " manure, remain entire in peat. Here the inflammable oils
 " and carbonaceous matter which abound in the fresh vegeta-
 " ble, and the latter of which also abounds in garden-
 " mould, remain entire; the soot and ashes too, which are
 " the results of the inflammation of each, seem to be nearly e-
 " qually fertilizing and in short, little seems to be lost in
 " peat, but the effects of the first fermentation, in preparing
 " the matter to undergo its future changes, with the rapidity
 " requisite to constitute manure. Besides the soil produced
 " from peat-earth, by exposure for a course of years, seems
 " not to be sensibly different from that obtained from dung
 " in the same way Both are deficient in firmness of texture;
 " but are very prolific when mixed with clays, sands, and cal-
 " careous earths, in due proportions.

" From considering the preceding circumstances, and from
 " trying what substances operated on tan, and on the acid
 " found in peat-moss, it was determined to subject it to the
 " influence of different sorts of fermenting dung, with due at-
 " tention to the proportions used, and to the effects of the
 " different preparations; and the following is the direction
 " which an experience of six crops recommends to practice."
 (Prize Essay, pages 143, 144 and 145.)

His lordship goes on to give particular directions for forming
 the compost. The moss to be used, he says, may be taken
 either from the top, or from the bottom of the strata, pro-
 vided only the turf on the surface be laid aside. That which
 is most compact, and fittest for fuel, should be preferred. The
 moss should be thrown out from the pit for a few weeks, till
 it is divested of some part of its moisture, then carted to the
 field, and mixed with fresh dung, into a compost midden,
 four or four and a half feet high. He recommends the first
 stratum to be of moss, six inches deep, dung ten, peat six,
 dung four, peat six, and then a layer of dung, and the whole
 midden covered over with moss. The materials should be
 thrown loosely together, and not trodden, as too much solidity
 would prevent the fermentation.

The quantity of dung to that of the moss should be regulated by the state in which these substances are when mixed together. If the dung happen to be fresh, and much disposed to fermentation, the moss free of turf, and tolerably dry, the quantity of dung need not exceed one-fourth of the compost; that is, one ton of such dung will be sufficient to mix into three tons of half dried moss. But if the dung is composed of poor meagre substance, has not attained its highest pitch of fermentation, or if the fermentation has proceeded too far, and the moss soaked in water, a greater proportion of dung must be used. As the purpose of mixing the dung into the midden, is to raise heat and fermentation in the compost, a greater quantity must be used in winter, than will do if the mixture is put together in summer. Dung from the shambles, or the dung of fowls, will ferment double the quantity of peat-earth that any other dung will.

“ The compost after it is made up, gets into a general heat, sooner or later, according to the weather, and the condition of the dung; in summer, in ten days or sooner; in winter, not perhaps for many weeks, if the cold is severe. It always, however, has been found to come on at last; and in summer, it sometimes rises so high, as to be mischievous, by consuming the materials, (fire-fanging.) In that season, a stick should be kept in it, in different parts, to pull out and feel now and then; for if it approaches to blood heat, it should either be watered, or turned over; and on such an occasion, advantage may be taken to mix it with a little fresh moss. The heat beside, after a time, and with great variety, according to the weather; the dung and perfection of making up the compost, which then may be allowed to remain untouched, till within three weeks of using, when it should be turned over, upside down, and outside in, and all the lumps broken; then it comes into a second heat; but soon cools, and is fit to be taken out for use. In this state, the whole, except bits of the old decayed wood, appears a black free mass, and spreads like garden mould. Use it weight for

“weight, as farm-yard-dung, and it will be found, in a course
“of cropping, fully to stand the comparison.

“Let it be observed, that the object of making up the
“compost, is to form as large a hot-bed as the quantity of
“dung employed admits of, and then to surround it on all
“sides, so as to have the whole benefit of the heat and efflu-
“via. Peat nearly as dry as garden-mould in seed time, may
“be mixed with the dung, so as to double the volume and
“more, and nearly triple the weight, and instead of hurting
“the heat, prolong it.” Prize Essay, pages 149, 150, and 151.

Compost, thus made up in January, may, if the frost do
not continue long, be ready for the spring crops. But in sum-
mer, it will be ready in eight or ten weeks, and if there be
any anxiety to have it soon ready, the addition of ashes, lime-
rubbish, or lime slaked in foul water, applied to the dung
used in making up, will quicken the process considerably.
“Both the power and the duration of the manure have now
“stood the test of a great variety of trials, on a considerable
“extent of ground, and of much diversity of soil, continued,
“without intermission, during the last six years. Hitherto it
“has been found equal, and indeed, preferable to common
“farm-yard-dung, for the first three years, and decidedly to
“surpass it afterwards. It has been conjectured, from the ap-
“pearance and effects of the compost, that its parts are less
“volatile and soluble, than those of dung; but that it yields
“to the crop what is requisite, by the action of the living
“fibres of vegetables; and in this way wastes slower, and
“lasts longer. Whatever be in this, nothing has appeared
“more remarkable, than its superiority in maintaining (for
“four or five years) fresh, and nourishing the pasture of thin
“clays that had been laid down with it, and in making them
“yield well when again ploughed, and that without any top-
“dressing, or new manure of any sort. It is believed,
“that the foregoing directions will, if practised, prove bene-
“ficial to every farmer who has access to peat-moss within a
“moderate distance; but it is to the farmer of the soils now

"mentioned (thin clay,) and of hungry gravels, to whom they would be found particularly valuable." Pages 155, 156.

This is certainly one of the most valuable discoveries ever made in agriculture. To convert a cart of dung into four, from materials of no value, and to be found every where at no expence, is a discovery of vast importance ; and if duly attended to, may, in a few years, greatly enrich the whole country.

This important discovery has also been controverted, and met with opposition from a quarter where it might have been least expected. Dr. Walker in his Essay, already so often referred to, says, (pages 54 and 55), " When a vegetable substance has past through the vinous, the acetous, and the putrefactive fomentations, it is then incapable of having these processes again renewed in it. Much peat, especially that of an ancient date, having been completely putrified, cannot therefore be again susceptible of any putrefaction. Some peat, indeed, appears to have been left only in a half putrid state, which may be concluded, from the branches and roots it contains, that still retain their natural form, though their substance is decayed. But this peat having remained for ages in moss-water, having become bituminated, and in consequence of this, powerfully antiseptic, it appears to be as incapable as the former of any further process of putrefaction. *If recent vegetables, or fresh dung, be intermixed with peat, they will ferment, and by their putrid effluvia, impregnate the peat-earth with fertilizing matter, but without exciting any degree of putrefaction in the substance of the peat itself.*"

Dr. Walker seems to have been drawn into the error he there teaches, by an over-desire to reduce every thing in agriculture, to an exact correspondence with what he conceives, to be chemical principles. According to his notions of these principles, putrefaction has already run its full course on the vegetables that contribute to the formation of peat earth, and therefore, that species of earth is altogether incapable of being again brought under that process, by the aid of lime, of dung, or any other admixture. I shall not pretend to dispute any of the general principles of science, or to doubt the knowledge

which Dr. Walker had acquired of these principles. But I am confident he is in an error in his application of them in the present case. If putrefaction had run its full course on moss plants, as it soon does on those that grow on dry land, nothing in the shape of moss would remain on the face of the earth. There is no state short of complete annihilation that can be pointed out as the utmost boundary of putrefaction. It proceeds more rapidly on some plants, and under certain circumstances, than it does on others or under circumstances less favourable. It may be retarded or interrupted, but whenever the cause of that interruption is removed, the destroyer will resume, and steadily pursue its course till every part of the organic texture of the animal and vegetable matter is entirely reduced. Generally it advances fastest at first, and slower when the more soluble peats are decomposed. Even in moss-earth putrefaction is still making some progress. If it had made no advances, the moss stratum would not have had the appearance of earth; but that of a hay stack or heap of vegetables. Whenever it has been formed under nearly the same degree of moisture, it is always more consumed towards the bottom than at the upper parts of the stratum.

Where putrefaction has completed its course, no moss-earth, nor any thing of vegetable matter, can remain; and wherever a particle of vegetable or animal matter remains undissolved, whether it be in the shape of moss-earth, or whatever appearance it may assume, it proves to a certainty, that putrefaction has been retarded, and has not completed its work. Moss-earth, according to Dr. Walker's theory of that substance, is wholly composed of vegetable matter not completely dissolved, but kept nearly stationary, or under a slow putrefaction by the force of its antiseptic qualities. To talk of putrefaction having completed its course while one particle of the vegetable matter remains undissolved is certainly incorrect.

When timber, utensils, or even human bodies are deposited in deep moss, the progress of putrefaction is interrupted, or at least greatly retarded, and the thing deposited kept nearly stationary. But no sooner are these bodies dug from under

the moss and exposed to the weather, or placed in circumstances favourable to putrefaction, than that destroyer resumes its course, and continues till the whole tree, plant, or body is completely annihilated. It is just so with the vegetable matter which composed the moss-earth; whenever it is separated from the cold damp moss, and placed among a warm sandy earth, or any other soil that is dry, warm, and abounding with fermenting matter, putrefaction is renewed, and in a short time every part of the moss is reduced, the vegetable fibre annihilated, and the moss formed into the food of plants.

The dung and the heat and fermentation which it excites in the moss-earth, overcomes the acid and other antiseptic qualities in the moss, and renders it soluble. And putrefaction once renewed, and the things that retarded it removed, it finishes its work of complete decomposition.

It is true, that neither calcareous earth, dung, nor any thing else can communicate putrefaction to substances that are incapable of that process; but it is not true that moss-earth, or any other vegetable or animal substance whatever, not totally annihilated, is incapable of being further reduced, and ultimately completely dissolved by putrefaction.

If moss-earth were incapable of all further putrefaction, it could never be useful as a manure, for no vegetable substance will operate as a manure, (except as a mixed soil) unless it be susceptible of putrefaction. If the Doctor were correct in that particular, all further inquiry on the subject would be to no purpose.

But fortunately for mankind Dr. Walker is not correct in that opinion. For it has been ascertained beyond all manner of dispute, that moss-earth can be made to operate as a manure. It has even been ascertained, in the most satisfactory manner, by many repeated experiments, made in all the counties of Scotland, by the most intelligent farmers, many of them conversant in science, that moss-earth prepared on the plan recommended by Lord Meadowbank, forms a manure equal to ordinary farm yard dung.

After his lordship had made the discovery public, I wished to be satisfied of its utility by experience. I did not then occupy any land on which I could make trial of its effects. But I caused many trials to be made by farmers, on whose accuracy I could depend, and many others who have made such trials of their own accord, have communicated to me the results. From these I can say, with the utmost confidence, that when properly prepared according to his lordship's directions, the compost of moss-earth and dung is equal to the same quantity of ordinary farm dung. I have many letters from the most intelligent farmers in different parts of Scotland, assuring me they have used that species of manure with great success. Some of these letters were written to me with permission to make them public, and I once intended to give them a place in this edition; but these communications have become by far too numerous for insertion. I could name hundreds who have used that species of manure with effect, and who are continuing to prepare part of it every year. And I have never met with one, who having made proper trial, did not own its effects to be equal to ordinary dung. These are to me worth a thousand arguments corresponding ever so much with chemical principles.

Lord Meadowbank did me the honour to show me the manner in which the compost was made up, and to accompany me through every field to which he had applied it; and explained to me verbally, every thing concerning that species of manure. I have had full communication with hundreds of intelligent Gentlemen and Farmers, who have prepared and used it. The result of the whole is the most thorough conviction to my mind of its utility.

The only thing I can add to what Lord Meadowbank has stated, is that in some cases it would be proper to use a larger proportion of dung than his lordship has mentioned. The moss-earth at Meadowbank is not flow-moss, but is found in small patches in low places, covered with a sward of meadow grasses, or those that grow on bent-moss. Some land water must, from its situation, have occasionally run on the moss, and must have

rendered it more friable, and more disposed to yield to putrefaction, than ordinary flow-moss on which land water has never passed. The dung too which his lordship has generally used in fermenting the compost, was also more disposed to putrefaction, than ordinary farm dung. It was either dung brought from Edinburgh, or that of his coach and work horses; for his lordship keeps few cows in the byres at Meadowbank.

When the compost is formed of moss and dung of these descriptions, the proportion which his lordship mentions (*one ton of dung to three tons of moss*) is proper, and will infallibly answer the end. But if real moor moss is used, and the dung chiefly that made from cows, it will be necessary to apply at least two tons of dung to five tons of moss, or if it is mostly cow dung, equal parts of each will be better. The purpose of the dung is to excite fermentation and putrefaction in the moss earth, of course the quantity used must be in proportion to the disposition in the dung to go into fermentation.

The fermentation will be much accelerated by mixing green vegetables into the compost. These may be found in many places, where they are allowed to remain nuisances: rushes, spritts, thistles, docks, nettles, ragweeds, marsh plants, &c. &c. may be found every where neglected, seeding, and poisoning the neighbouring fields. Much bulky herbage might be found in woods and plantations, under hedges, and on road sides, that if cut when in their greatest luxuriance, would greatly accelerate the fermentation in moss compost, and add to its volume by the substances of which they are composed being reduced to dung. Sir James Stuart Denham of Coltness, frequently employs labourers to collect such seeds and plants, and apply them to hasten forward and enrich the compost.

I would also recommend to throw out the moss to be used in this species of compost in the beginning of winter, to be exposed to frost before it is made up with dung. The frost breaks and loosens its texture when it is newly dug, and makes it much more friable.

Lord Meadowbank mentions, that after the compost has been fermented it becomes a friable mould. But this is not to be expected if either flow or bent-moss be used. These are more fibrous and luxuriant than the small patches of meadow or moss found at the foot of arable land. Exposing the moss to frost before making it into compost is the best way to reduce its tenacity. But if that should not be completely reduced, still the compost will, if duly fermented, prove excellent manure. Moss compost is often lost or rendered of less value by being treated in a slovenly way, and being used as manure before it is properly fermented and brought into a course of putrefaction. The generality of farmers treat their dung so improperly as greatly to diminish its value. They perform every operation about it in a careless sluggish way; leave it exposed to the weather, the sun, and every privation. Their mode of making up the moss compost is frequently no less slovenly; they do not attend to the qualities either of the moss or dung which they use, to the soil on which their operations are carried on, nor to the relative states in which these ingredients are found. A heap of dirty straw laid on the dung stead, or that which has been decomposed almost into garden mould; every thing in fact that ~~has~~ found its way to the midden, whether fermentation has begun, or if it have exhausted its powers, obtains the name, and is applied to the purpose of dung.

In making up the compost, the quantity of materials should be according to the disposition they have for fermentation, and they should be kept together in the heap till putrefaction is not only begun, but till it has made considerable advances.

The moss should be dug up and thrown into heaps in the early part of the winter, mixed up with the dung next spring or summer, and remain not less than six months, or if possible a year in the midden.

The Earl of Moira wrote me, that it would be desirable to try whether fermentation excited in one part of a considerable mass of peat-earth (dried to the proper degree) would communicate to the whole heap, and save the necessity of mixing dung into the whole. I caused different trials to be made, but

I did not find that the fermentation extended much farther than the admixture of dung by which it was excited.

Farther discoveries will I trust be made on that subject; but till these are known, the great object should be to get the possessors of land to prepare and use that species of manure according to what has fortunately been brought to light on that interesting subject. To be able of a material which abounds every where, and that can be obtained almost without labour or expence, to double or triple the quantity of dung every year, on every farm, is one of the most important discoveries of the present age. A double or triple quantity of dung should surely produce a corresponding increase of crop. That in its turn will augment the real dung of next year. If that increased quantity is again used in fermenting as much or twice as much as its own weight of moss, and so on from year to year, the measure of dung, and of course the increase of grain, would soon exceed our most sanguine expectations.

Unfortunately a prejudice, and an unaccountable indifference still prevails with the greater part of the occupiers of Land, against that valuable manure. The cause of that indifference and inattention is to me surprising. There are few parts in Scotland but it has been used with such success, as to establish its utility beyond all doubt, yet though almost every farmer knows of it, and has seen its effects, still few of them, comparatively, have begun to make it up and use it.

To remedy this, I would advise every proprietor of land to bind his tenants, to prepare and lay upon the ground they occupy, as much every year of moss as the amount of the dung the farm could be supposed to produce. Where the lands are already under lease, intimation might be given to the tenants, that if they did not attend to an improvement so interesting, during the present lease, they would be removed from the estate as soon as it terminated.

If the Proprietors of Estates would adopt such a resolution, and carry it into effect, the value of many Estates, and the produce they yield, might be doubled in the course of twenty years from that improvement alone. To neglect enforcing, by

example and precept, the use of this manure, is to neglect one of the most important duties a proprietor can perform to his family, his tenants, and to the commonwealth.

It cannot be thought arbitrary or an improper interference in proprietors, to exert their utmost influence and authority in enforcing an improvement, so well ascertained to be for the interest of the tenant, as well as themselves, and by which too, the national prosperity might be so much promoted.

Some plead, as an excuse, that they have no moss in their possession, or within a reasonable distance. This is a mere pretence. In two third parts of all the land in Scotland, moss, sufficient for making compost, may be found within a mile. Unless it be in some parts of the Counties of Edinburgh or Haddington, there is scarce one farm in Scotland, on the south of the Forth, but can have moss within five miles; and not one farm out of a thousand but may find it within three miles. It is no uncommon thing in some parts of Scotland to purchase lime or dung at 5s. per ton, and carry them ten miles for manure; while moss, which might be found on the farm, or within a mile or two, for lifting, is altogether neglected.

In a time like the present, when a single year of scarcity would endanger the national independence, what subject can be more deserving legislative interference? The abolition of certain orders in council, or parts of our maritime code, is all that is now demanded, to lay open to us the granaries of America. But can we trust that the ruling faction in that country would not raise their demands, if (as God forbid) they saw us in want of food? Let us therefore provide for the evil before it reach us. Let our mosses become sources from which our industry shall fill our granaries, to meet a year of scarcity; and let the discoverer of that source of wealth be hailed as the Joseph of his country.

SECT. V.

Moss converted into Manure by various means.

Moss-earth may be rendered an efficient manure by various other preparations. Any thing that will reduce its insolubility and bring on fermentation and putrefaction, will convert moss-earth into manure.

Putrid-water will also reduce the insolubility of the moss-earth, and convert it into manure. A great deal of corrupted water is suffered to remain, in a state of stagnation; a nuisance, highly injurious to the health of mankind. The quantity of putrid water that might be collected in towns and villages is immense; and the peat-earth it would convert into manure, is beyond calculation. At present it is not only lost, but the health of the inhabitants is much injured by its vapours.—Were dry moss thrown into the stanks and sewers, or the putrid water removed daily, and used in forming moss into manure, an immense quantity of dung might be made, and the health and cleanliness of the inhabitants promoted. Stanks of putrid water are not confined to towns and cities, they are to be found in every paltry village, and farm-house, and even at the door of every cottage. The richest juices of the farmer's dung are still suffered to waste in these ugly stanks, the *mid-den-dub*; nuisances which neither the prospects of gain, the comforts of cleanliness, nor a sense of decency, have yet been able to banish from the generality of farm-houses. The fat juices from the cheese-press, washings of milk vessels, offals of the kitchen, &c. are neither collected for manure, nor carried off in proper sewers; but generally preserved in some nasty stank near the door, or at the house side, raising, in hot weather, an unpleasant and unwholesome smell. This want of decency, inattention to health and to cleanliness, the essentials of human happiness, so much prevail, that almost every cotter and peasant, must have some nauseous stank, more or less, according to his rank, at or near his door. If he cannot store

it with the urine of cattle, or the fat and offals of milk, as much of the urine and ordure of the family, and every refuse of the house, will be devoted to it, as to render the water putrid, and cause it send forth an unwholesome stench. You can seldom approach the door of a farmer or a cotter, but your eyes and your nose shall be hurt with the disagreeable sight, and the nauseous effluvia of a midden-dub, suited to the rank of the family, often in front of the main door. If dogs, cats, rats, &c. happen to be killed about the house, this grand nuisance, the midden-dub, forms their common grave!

It may not be easy, at all times, to prevent water from becoming putrid, in the vicinity of houses or villages; but it is certainly possible, and highly proper, to convert it to some useful purpose, and prevent the inhabitants being poisoned with its putrid vapours. No method can be so proper, as either mixing into the corrupted water, so much half-dried moss-earth, as will absorb the putrid moisture, and then removing the moss into a dung-hill, or collecting the water, and mixing it in a convenient place with moss, which would be thereby converted into an excellent manure. Ponds might be formed, and the water rendered putrid, for the very purpose of making moss into dung.

The water into which green flax has been laid in steep, would also serve to reduce moss into manure. Green lint, with its seed, contains a large quantity of oil, and much vegetable juice, which the water wholly extracts. By our present economy, all these oils and vegetable substances, are not only lost, but are suffered to become a great nuisance. The fishes are killed, and the health of mankind and animals are much hurt by the effluvia raised from the lint-hole. Flax ought never to be laid in steep in a running stream, but in a standing pool; and the water, with the juices extracted from the lint, should either be used to mix into half-dry moss, with or without dung, or green vegetables carefully preserved, and spread upon the land. Such rich sap should not be thrown away. Were it duly preserved for mixing into moss or common earth, or even laid upon the soil of the neighbouring field, the lives

of millions of fishes would be preserved, and the health of man and other animals less injured, not to mention the revenue that might be raised by such industry.

Urine, if mixed into half-dry moss, will reduce its antiseptic qualities, and render it soluble. It should therefore be carefully preserved, and applied to that purpose. The pavements of byres and stables should be laid on a bed of clay, and the urine either collected into a well, where it could be taken up with pails, or run into the dung-hill. The dung-hill should be placed on the north-east side of the houses, so low that the urine would fall into it, and ought to be as much as possible sheltered from the effects of the weather, and from the exhalations of the sun; or, as much dried moss might be thrown daily into the floors of the stable and byre, as would absorb the urine. This would be attended with two advantages. The volatile alkali with which the urine abounds, and is the best food of plants, but which is generally washed away by the storms, or exhaled by the sun, would be preserved by the moss, and these substances would render the moss soluble.

The fumes of the dung, while under fermentation and putrefaction, might also be used to reduce the insolubility of a vast quantity of moss. While dung is under fermentation, much of its richest substances, the very best food of vegetation, are thrown off in gas, exhaled by the sun and winds, if the dung-hill is exposed, or washed away by the storms, and totally lost to the proprietor. All this privation might be prevented, by laying the dung in regular and level strata on the dung-hill, and covering it with a stratum of half-dry peat-earth, sufficient to screen the dung from the injuries of the sun and weather, and yet not too heavy to retard the fermentation of the dung. The rich gases thrown off while the dung was under fermentation, would be caught and retained by the super-stratum of moss-earth, and prevented from going off in air; and that gas would bring the peat-earth into putridity, and thereby greatly enlarge the volume of the dung-hill. The covering of moss would shelter the dung from the severity of the weather, and

the exhausting powers of exhalation, which, in the present economy, reduces the dung one-third in its value.

The Earl of Dundonald, in his treatise on the connection between chemistry and agriculture, has shown that not only various kinds of saline substances might be used to reduce the insolubility of moss, but that even sea-weed, and sea-water, may both be made to serve the same purpose.

Unfortunately the farmers are not acquainted either with saline compounds, or the mode of using them, not to mention the expence they would cost. Sea-weed cannot be obtained to any great extent, and sea-water can only be used near the shores.

Animal substances will render moss-earth competely soluble, and convert it into the best of manure. Lord Meadowbank takes notice of this, and mentions, that, with the body of a dead horse, ten tons of moss may be made into a rich dung. From an experiment I caused a friend of mine make, I can, not only corroborate the fact, but assert, that from the body, blood, and intestines of one horse, properly mixed with moss, and fermented by it, with the aid of some weeds or other green vegetables, all twice or thrice turned over, no less than eighteen or twenty tons of rich dung may be formed in the space of seven or eight months. The fumes of the putrid animal substance reduces the moss-earth to complete solubility, and the moss-earth catches and retains the effluvia of the putrid animal matter, prevents it from being carried off in gas, and preserves it to enrich the soil to which the moss is applied. How commendable would it be to dispose of dead horses in this way, in comparison with throwing them into a ditch, to become the prey of ravens and dogs, and where the fumes of their carcases under putrefaction, become obnoxious to man and beast? Twenty, or even ten tons of rich dung, worth from five to seven pounds, obtained at the expence of only a few shillings, in labour, is surely a sufficient reward for such a piece of industry, besides preventing the air from being poisoned. The Justices are probably empowered to compel people to such acts of industry, but they certainly have power to prevent the putrefying carcases of animals from remaining unburied.

Not only dead horses, but the carcasses of all animals not fit for the use of man, and all the offals, blood, and intestines of such as are so used, ought to be disposed of in this way. The blood and garbage of one fat cow, if carefully preserved, and duly mixed with half-dry moss, would be sufficient to make several tons of dung. If only the one-half of that substance were so applied, many thousands of tons of more dung might be made every year. Moss is to be found within a moderate distance, in almost all parts of Scotland; yet the blood and garbage of cattle slaughtered, even in country towns, where moss could be found often within half a mile, are generally thrown to the streets, to find their way to the rivulet. It is not uncommon in a dry warm day, to see the sewers along the side of a street filled with clotted blood, which remains till the rains wash it away. Much of the dung found in the belly of the animal, is, with her calf, if she has one, disposed of in the same manner; or, if any part of them be carried to the butchers' midden, probably in the centre of the town, the dogs soon scatter them over every street and lane; an intolerable nuisance, and extremely injurious to the health of the inhabitants; and which gives but an unfavourable idea of the police of the place, and the manners and taste of the people. Their health, comfort, and pecuniary interest, would be much promoted, by mixing the blood and offals of every beast that was slaughtered, with moss-earth.

Many cows, sheep, and other animals, die every year, unfit to be eaten, and their carcasses are generally suffered to remain where they fall; or, if at all removed, it is only to the next ditch, where they serve for food to the ravens, dogs, &c. and poison the air. The quantity of dung such carcasses would make from moss, would be very considerable, while their pestilential effects on the atmosphere would be prevented. No description of manufacture could yield so large a profit, as that here recommended. Dung, before it can be brought to the field, must cost ten shillings, or perhaps fifteen shillings per ton, while from the mode here mentioned, it may be made for less than a shil-

ling per ton, and if a just value is only put upon the other advantages to be derived from the practice, at much less than nothing.

It was truly patriotic in the Highland Society, to offer premiums for further discoveries, as to the mode of making moss undergo the putrid fermentation. Every person who has the good of his country at heart, will sincerely wish that their success may be as great as their benevolent intentions are praise-worthy. But till such discoveries are made, we ought to persevere in the use of what is already known. The modes of forming moss into dung, are by no means despicable, if farmers and others could only be prevailed upon to reduce them to practice. Industry is the chief thing wanted. By the different methods that have been pointed out, of forming dung from moss, many farmers who have moss in every farm, often in every field, might increase their dung to more than four times its present quantity, and thereby, in a few years, more than double the produce of their lands. Industry is all that is necessary to accomplish this end. While the Highland Society are offering rewards for new discoveries, I would recommend to the great land proprietors who have moss on their estates, to offer premiums to such of their tenants, as should set the best example of industry in the modes already known, and appoint a person skilled in these matters, to teach them how to reduce them to practice.

Many have reprobated the use of lime as a manure, alleging that it injured their lands. But all own the utility of dung, which they and their fathers have used as manure from time immemorial. The high price of the article, great expence and toil of carriage, want of good roads, unskilfulness in carting, unpleasantness to handle, fear of running risk, &c. still serve to keep up, with some, the prejudice against lime. Here then is a species of manure every way suited to the taste of the inhabitants. It can be obtained often on every field, the carriage seldom more than a mile or two, often no more than a ridge's length, no roads needed, soft and easy to handle, no risk to run, no money to advance. This species of improvement must

be every way to the farmers' wish, and I sincerely hope and trust, they will soon enrich themselves by it.

CHAP. III.

MOSS AS SOIL WITHOUT CULTURE.

SECT. I.

Of Moss as Pasture.

MOSS SOIL, in its natural state, produces some herbage, though neither bulky nor of the best quality. The plants that grow on the different kinds of moss, have been mentioned in Botanic terms when treating of the origin of that species of earth. In the eye of a store farmer, they consist chiefly of *Fogs*, wet and dry; as the *Hypna*, *Sphagna*, *Brya*, *Polytrichon*, &c. *Bent* herbage, as the *Nardus Striçti*, *Juncus Squarrosus*, *Eriophora*, &c.; and in the *Hill* and *Bent-moss* a mixture of grasses, rushes, spritts, &c.

The herbage on flow-moss is of no value. That on hill and bent-moss is capable of supporting a puny breed of sheep; and some times black cattle roam over ranges of moss pasture, but it is chiefly stocked with sheep. The breed of sheep will always be in proportion to the quality of the soil, and mode of treatment. When a large portion of their pasture is dry, covered with green herbage, and tolerably sheltered, the breed, if well managed, will be good, and the wool valuable. But when pastured on flow-moss, intersected with deep gutters of moss fogs, and destitute of shelter, the breed can neither be good, nor the wool fine.

As the quality of the stock, and that of the wool, depend in a great measure on the quality of the pasture, the most impor-

tant inquiry concerning that description of soil is, how it can be improved, so as to be capable of rearing and supporting a better breed, and producing finer wool.

Draining as much as possible the moisture from the surface of all sheep pasture, especially where the soil is chiefly moss, is the first and most necessary improvement. It has been shown that an overcharge of moisture stagnating on the surface, is the source from which all moss-earth has proceeded. It is equally certain, that in proportion to the quantity of water detained on the surface, the herbage becomes of less value. Wherever much moisture is detained, all the rich grasses die, and the fogs grow up. And if these stanks or gutters which these fogs form are laid dry, the fogs disappear, and the richer herbage rises over them.

A large proportion of all moss pasture is laid under so much stagnated water, that every sweet grass is banished, and the poor sheep is doomed to wade to the belly, through stanks and gutters of vast extent, of soft Sphagnum, swimming on water, in order to pick up a miserable subsistence from the intermediate hillocks.

These evils might be remedied, by opening with a spade or plough, small channels, or open drains sufficient to remove the stagnated water from every part of the soil. Whenever such drains are opened in proper numbers and form, the soil becomes much more solid; the Sphagnum or moss-fog ceases to grow, and an herbage much more palatable and nourishing rises over the surface. The proper size of these drains is about twelve or sixteen inches broad above, near a foot in depth, and slanted on both sides, to about three inches at bottom.

The number of such drains must vary according to the state of the moss. They ought in all cases to be sufficiently numerous, to carry off the whole stagnant water from every part of the soil. The earth or turf cut from those drains ought to be laid in the hollow places of the surface, and some of the knolls should either be thrown into the low places, or the drains opened to relieve every part of the surface of all stagnant water. In some situations, a large range of moss may be laid dry with a

few drains; in others a much greater number become necessary. But whatever be the number of drains required in any particular spot, no doubt need be entertained that the value of the generality of all the moss soil in Scotland, that has not already been drained, would in a few years, be doubled by being properly surface drained.

Some part at least of the draining here recommended, might be executed by the shepherds, while tending the sheep, and without interfering with their duty to their flock. But the indolence of the pastoral life is unfavourable to such laborious exercises. The herds prefer loitering on the moors, nearly idle, or knitting stockings for about *twopence per day*, to any description of spade-work. Could shepherds be prevailed upon to lay aside their plaids and stocking-wires, and take up their spades for one-fourth part of their time, which they could easily spare, without injury to themselves or the flocks; they might nearly double their own wages, meliorate the condition of the flocks, and in the course of an ordinary lease, double the value of the sheep-walk. These drains are usually paid for at the rate of three farthings for six yards in length; and those who are accustomed to that kind of work, will, at these prices, earn four or five shillings per day. If a herd would only labour at the drains for three hours every day, during nine months of the year, which all of them might easily do; the whole sheep pasture might be sufficiently drained in a few years, and the herds, the tenants, the proprietor, and the public greatly benefited. A shilling for these three hours labour every day, would amply repay the herd; better pasture would improve the stock and the wools, and thereby repay the tacksman. The proprietor would reap the advantage in a great increase, perhaps double rent next lease, and the interest of the community would be promoted, by the greater abundance of mutton and wool, and in the melioration of the climate which that improvement would infallibly ensure.

I have known some herds, tempted by the profits it brought, begin to drain the sheep-walks under their charge. But such is the force of indolent habits over those who are enslaved to them,

that they seldom gained more than a few shillings by such labour. Finding the draining irksome, they took up their plaids and stocking-wires, as the Hottentot does his pudding; laid up the draining spade to rest, leaving the sheep to wade through the gutters, as formerly.

Surface-draining the sheep-walks in Scotland is a matter of importance, and would lead to such improvements on the stock, the wool, the land, and the climate, as loudly to demand the attention, not only of the proprietors and possessors of that species of soil; but also of the Legislature. The improvement of the breed and wool have long attracted the notice of many of the Noblemen, who have seen in its proper light, the high importance of such improvements. Something has been done, and may still be effected, by introducing improved breeds of sheep, or crossing the native breed with those that are better. But the only certain way of mending the breed and the wool is, to meliorate the condition of the stock, by providing for them better pasture, and the chief improvement that can be made in the pasture, and indeed the *sine qua non* of every improvement is to lay it dry by surface-draining.

Improved breeds may be brought to our moors, and crosses may be raised, but unless the condition of the stock is bettered these breeds and crosses will always degenerate to that which is suited to the state of the pasture. Even the native breed will be improved by bettering their condition. The patriotic intentions of the *Wool Society* would be greatly promoted, by a *Surface-Draining Society*. It was an over-degree of humidity that formed the moss. Its increasing depth has proceeded from the same cause. And though draining the surface may not remove the deep beds of moss already accumulated, it will arrest their growth, and prevent further accumulation of moss; extirpate from its surface the Sphagnum, and worst moss plants, and gradually introduce a finer herbage. That improved herbage being soluble, will gradually enrich the soil. The moss-earth, relieved from moisture, will consolidate, and by the help of a finer herbage on the surface, and the dung of cattle that eat up such herbage, will become a black mould, which, with

the help of a dressing of lime, marl, or earth, might be rendered fit for raising the best of grain, and richest pasture grasses. This is the true way of improving the breed and the wool of sheep.

Flooding of clay, sand, or earth over moss, is practicable in many places, and would, when properly conducted, greatly improve the pasture. Many of the mosses of least value might, at small expence, be greatly improved by this species of irrigation. Reclaiming even a few acres of flow-moss in a sheep walk, and turning it into richer pasture, is a matter of great importance. In many places great improvements could be made on the herbage, by carting on top dressings of sand, earth, or clay enriched with marl or lime. It is well known that a dressing of lime laid on any barren heath, where the surface is laid dry, will, in one year, raise a rich carpeting of white clover, and poa-grasses. The cleanings of roads and ditches, or other earth fermented with lime or marl, will produce the same effect; and clay, sand, or any other earth, even without lime, will double the value of the pasture.

Clumps and *Belts* of trees raised here and there, on the sheep walks, for shelter to that valuable, but neglected species of stock, would tend to meliorate their condition, and improve the breed, as well as ornament the dreary wastes which are stocked with sheep. It will be shewn in next section, that the raising of such belts and clumps is practicable, and their utility in sheltering the sheep, as well as in beautifying the country, must be obvious.

SECT. II.

Plantation on Moss.

THAT trees may be raised and attain considerable perfection on a moss soil, is a matter that can admit of no doubt. Thriving plantations growing on moss are so common in all the counties of Scotland, and in different parts of England, that to enumerate instances is unnecessary.

It is not to be expected, however, that every species of trees will thrive equally well in every soil and situation. In the wonderful economy of nature, trees as well as grasses, are provided for almost in every possible diversity of soil, climate, and situation, which gives great scope to the industry and ingenuity of man to make the proper selection. If we would expect plantations to thrive on any soil, we must make choice of the species that are best adapted to that soil, and to other relative circumstances. In a moss soil, such a selection becomes still more necessary: The depth and qualities of the moss, altitude in which it lies, humidity of the soil, nature and qualities of the subsoil, &c. ought all to be attended to, and the species of trees selected that were suited to local circumstances. In this, as in cropping of the fields or the garden, nature has left room for the exercise of talents, and holds out rewards for industry.

A deep flow-moss is certainly not the soil best adapted to the growth of trees or of any useful plant. But if that moss is properly drained, Alders, Birch, Mountain Ash, Poplars, Pine, Willows, Larch, and all the other species of aquatic trees will grow, and attain considerable size, even in a deep flow-moss. All of those have, in former ages, grown spontaneously in moss, of such depth as completely precluded the roots from reaching the subsoil. Oaks and Elms are the prevailing trees on a subsoil of clay, and firs on that which is sand, gravel, or free rock. These are the remains of the original forests, the overthrow of which led to the formation of the mosses. But beside these, immense numbers of Alders, Birch, Saugh, Firs, &c. are found every where enveloped in the middle of the moss stratum. There are also found the roots from which these trees had grown: They are generally found adhering to the trunk, as in the case of the Birch, Alder, &c. But I have also found the roots of fir trees of a thickness nearly equal to the largest now growing in Britain, standing in the natural position, and in the very spot in which they grew, with their massy tendons far extended horizontally in the moss. I found lately on a deep moss, on the Estate of Glessnock, Airshire, several feet above the subsoil, many roots of fir trees, of a size equal to the largest

in that neighbourhood. Their numerous fangs, of great thickness, are extended round to a considerable distance in the moss many feet above the subsoil, and the trunks seem to have been cut with an ax or saw, and removed. A stream of water had found its way under one of those roots, and excavated a channel four or five feet deep, under the centre of the root. The tendons being strong on both sides, the root serves as a bridge over the burn. I walked over this bridge of nature, and also went under it; where I sank a stick more than four feet into the moss without finding the subsoil.

It is evident, that this large fir tree has grown in a soil of pure moss of more than eight feet in depth. The roots have not sunk perpendicularly, but, as the roots of firs always do, extended horizontally near the surface, within reach of the air, heat, and rain water. Many such roots of large fir trees may be seen in that moss where it is from 6 to 15 feet in depth, and I have seen many such roots in various parts of Scotland and England. In some parts of the Highlands, two or three courses of fir trees are found in the same moss, at different heights above each other, each course having begun to grow after the generation below had been overthrown, and the moss risen high over them. I have seen firs growing spontaneously from seeds accidentally dropt in very deep flow-mosses; they would certainly grow better if the ground were prepared and fenced.

The spontaneous growth of such trees in mosses so deep, and in a state of nature, proves that trees will grow in that species of soil. I have also found large roots of oak trees in the same natural position, where none of the roots had reached any part of the subsoil, but grown in moss only. The first of these I ever noticed, was in Badenoch, where the road had been cut deep in a moss: The roots and tendons of oak trees of large dimensions were visible in the section of moss, three or four feet above the bottom, and where none of these roots had reached the subsoil. I found the same thing at Castlehead Moss, in Lancashire, where a canal had been cut; and I have since seen the like in different parts. This proves,

that even Oaks will grow to great magnitude in a moss soil. Indeed I found Oaks, Elms, and Ashes, that had been planted on deep moss at Castlehead, growing luxuriant from one to three feet in circumference. I found them of nearly the same size at Scaleby Castle, in Cumberland, and at Cumlungan, Dumfries-shire; they are growing luxuriant on the other side of Locher moss, near Dumfries, and in many parts of Scotland, though not of great size.

Where the mosses are so thin that the roots of trees can reach the original soil, every species of trees that are suited to that soil will still grow. If the subsoil is clay, Oak will still grow. If it is sand or freestone rock, Firs are the proper plants.

When trees are to be planted on moss, it will be proper to cut open drains, four or five feet deep, at the distance of every twenty or thirty yards or so, and to form the space between these ditches like a ridge, or in such a way that no water can at any time rest on the surface. If a flow-moss is drained and formed into ridges in that manner, trees of the aquatic kinds, and even Ashes, Elms, Oaks, &c. will grow to a size sufficient for country uses. But it is in vain to expect that trees will grow to much perfection in moss, unless it is drained and formed in that way.

Independent of profit from the timber, plantations on moss and moor ground would be of unspeakable advantage in screening the land, ornamenting the face of the country, hiding from the eye the unsightly and gloomy aspect of these wastes, and sheltering the helpless animal, that is doomed to spend its life in such exposed and stormy regions. These considerations alone, ought to induce proprietors of such land, to shelter and decorate the moors and mosses with clumps and belts of plantations, of such dimensions as might suit their taste, or prove most useful for shelter and ornament.

In a level flow-moss, a ditch might be cut from four to six feet wide, and about the same depth round the piece of ground to be planted, this would lay it dry, and serve as a fence, till the trees got up beyond the reach of cattle. If the space was large,

some cross drains of the same dimensions should be formed, and by the earth dug from the drain or otherwise, the whole space formed so as to discharge the water.

In elevated situations, the first object should be to make choice of a spot, from a rood to an acre of land, of a soil most propitious to the growth of trees, and least exposed. Round this a dike of sod might be raised, about six feet high, to fence and to shelter the young trees.

I know no way in which the proprietors of moor ground could lay out some part of their money to better purpose. Less than one year's rent would defray all the expences of the ornament and shelter here recommended; the price of one farm would beautify and screen twenty more farms of equal size; and if executed with propriety, any one of them, would, in twenty years after, sell as much higher as the greatest part of the expence of planting the whole.

CHAP. IV.

OF MOSS AS A CULTIVATED SOIL.

SECT. I.

Draining Moss for Cultivation.

THE first step towards the reclaiming of moss for a cultivated soil is, to relieve its surface of all stagnant water. Until that is completely effected it is in vain to apply manure, or attempt to raise grain or valuable grasses. It has been shown that the stagnant water on the surface banishes the richer vege-

the moss is broken up. It renders the moss more solid, and sooner fit to support the feet of horses. If these drains are not opened till the moss is laboured, all that is then necessary is to form the surface into ridges and furrows, the former from twenty to forty feet broad, raised six inches in the middle, and the latter a foot wide, and ten to twelve inches deep: Such furrows, with open casts at the end of the field, into which the water would run, is all the draining that is necessary in any moss.

Whenever a moss is either by nature or art rendered drier than such furrows would make it, instead of being benefited, it is thereby greatly injured. Proofs of this may be seen at every flow-moss. When these mosses have grown up to a considerable height over the original soil, the water in times of rain forms little channels, first on the outside of the flow, where the declivity is greatest, and which in course of time, extend over the moss, turning it into alternate hags and hillocks. Many of these knolls, do not contain more than a fall or two of ground, and are surrounded with hags or gullies, four, five, or six feet deep. If draining could render moss solid and fertile, these knolls would certainly be valuable. But the fact is, they are of the least value of any part of the moss. The only herbage they contain is a few stunted twigs of heather, and some dry fogs. In many cases twenty acres of such ground would not keep alive one sheep. Indeed, a sheep would not live one winter on twenty thousand acres of such pasture.

If these hillocks were levelled, and manured like other moss soil, still they would not be productive. This does not proceed from the moss being too wet, but from its being too dry. If moss is not kept in a moist condition, between wet and dry, it will neither yield grain nor good grasses. It is as much injured by being too dry, as by being too wet.

If the least inequality is allowed to remain on the ridges, the crop will fail. The low parts by being too wet, and the haughs however small, by being too dry.

The soft damp state in which moss is found, has induced many to believe that draining will remedy that defect; and

that the more the moss is drained, the more valuable will it become. Most of those who have written on moss, seem to have gone into that error, and speak of draining, under-draining, and even trenching the whole surface two feet deep to render it dry.

Moss in its natural state is no doubt overburdened with idle water on its surface, which banishes every valuable plant ; and being a light, open, spongy substance, the water is detained on the surface, sinks into the moss, mixes with it, and renders the whole stratum moist and soft. All that proceeds from the water being allowed to stand on the surface, detained with the moss fogs, and having no proper channels to carry it off. But if channels were opened over the surface, so as to give facility to the escape of the rain water, the moss would become much more solid, and productive of better herbage.

But if the draining is carried further, it renders the moss incapable of producing either grain or any valuable herbage. Moss, after it has been formed into a soil, takes in, and retains, without fluidity, a larger quantity of water than can be retained by any other earth. This is no doubt an excellence in that soil ; but unfortunately it more readily parts with that moisture than any other soil will do, and becomes in a short time so dry, that it cannot support vegetation. Water does not filtrate through solid unbroken moss, but when once the moss is reduced to mould, the water percolates with the greatest ease. The sun and wind exhale moisture from moss much faster than from any other soil. It is so light, open and incohesive, that the sun and dry winds will divest it of moisture to a greater depth in one day than it can do some other soils in a week. A drought of even a few days will evidently hurt the crop on moss. If that drought happens in the month of April or May, the crop is lost. If it happens in June, or when the crop is in blade, it will support itself on the dews, and what it collects from the atmosphere, and by that means keep alive till the rains come to its relief. But if the drought happens when the plants have attained full stature, and begun to form the seed,

the effects are more injurious to the crop. The leaves or foliage of the corn having lost their powers of collecting the aerial fluids, and the plants being then chiefly supported from the soil, if that soil is void of moisture, the crop must be starved; and if the drought be of long duration, it will produce no grain. The sides of ditches or furrows, or little haughs on the surface, will always be the soonest injured.

Mr. Nasmith, though he argues for many deep drains being cut in the moss, as a primary operation, yet he admits that in drought the crop fails first on the sides of ditches, and places elevated above the common level. But he seems unwilling to attribute that failure to over-draining. He says, it proceeds from the want of an admixture of some other earth, which he thinks would fill up the interstices from which the water has been exhaled by the drought.

The remedy which he proposes is probably the best that can be applied. But the propriety of first rendering the moss too dry, at so much expence as the draining must cost, and afterwards having recourse to one still more expensive to remedy that evil, is not to me sufficiently obvious. A Doctor who had brought his patient under a dangerous disease, merely to show his dexterity and skill in applying the best remedy, would ask his fees for both applications with a very ill grace; and could have no good right to expect the confidence of his patient. The moss Doctor who prescribes over draining, and then a still more expensive operation to correct that error, would stand in the same predicament. Clay, earth, or sand are proper manures for a moss soil. But I do not perceive the propriety of laying the moss too dry, merely to show the effects of these admixtures in correcting the error. What he says in the same sentence about the fibres of the moss preserving their elasticity, and forcibly repelling each other, seems to me to be fanciful. I know of no elasticity, or other quality, in the fibres of the moss-earth, by which they can repel each other.

Mr. Nasmith is not so blind to the same errors when committed by other improvers. He says, page 70, that the Airshire method of giving the ridges a high convex form, does not

appear to be judicious, and mentions, that he found the crop had failed in the middle of these high ridges, the soil being too loose, and parched by the summer's drought. Mr. Nasmith is certainly correct in what he there states. But if raising the ridges a few inches too high in the centre, proves so injurious to the crop, must not an unnecessary number of drains have the same effect? And must not the expence of forming these drains be worse than thrown away? Clay laid on the heights of the Airshire ridges, would in some measure remove the evil there as well as where Mr. Nasmith proposes to apply that remedy. But it would, in my opinion, be better to avoid the expence both of the evil and the cure.

The ideas of Dr. Anderson, as stated in pages 99 and 100, of his Treatise on moss, coincide so much with my own, as to the bad effects of laying moss too dry, that I cannot better express my mind on that subject, than in the words of that learned writer, " Moss when thus reduced to a dead state, to a sufficient depth, is in little danger of ever being too damp, unless the main drains are choaked up, so as to force the water to rise very near to, or above the surface. Indeed, if no manure be given to it, moss is never extremely productive either of grass or corn, *unless it be kept moderately moist at all times.* The soil is of itself so light, that, when dry, it ceases to give nourishment to any useful plant whatever. Such dry moss produces little else than narrow leaved sorrel (*Rumex Acetosella*), and if ploughed and sown with oats, *though the corn may spring up and appear healthy enough for some time, yet when it gets into the ear, it becomes weak and soft in the stalk, and falls over and withers, before there can be the smallest mark of kernel in the grain.* This disease is well known in all moss countries, and as it was originally believed to be occasioned by *witchcraft*, the name still remains; it is called *witched corn.* *If on the contrary, the land be flat, and it be kept moderately moist, without being wet, it produces excellent corn and grass."*

I concur in opinion with the Doctor, in every thing stated in the paragraph here quoted. But I think he has said too much

in some pages preceding that passage, about draining, under-draining, trenching two feet deep, &c. to dry the moss.

The extreme softness of the moss is an incurable defect in that soil. It is too soft when wet, and it is too soft when dry. And as no soil can support the growth of plants, unless it contain the moisture necessary for their food, the whole care of the cultivator ought to be, not to render the moss dry, which it too readily becomes of its own accord, but how to prevent it from becoming too dry. For that reason I beg leave to caution the cultivator of moss against trenching, under-draining, opening too many drains of any kind, or doing any thing that can tend to facilitate the escape of moisture from the cultivated moss soil, further than that no stagnated water be allowed to remain on any part of its surface.

But I also mentioned in the introduction to this subject, that if further draining were necessary, the covered drains, or other drains whatever, can be of no use in the moss, except in facilitating the escape of water from the surface. In that view drains are necessary, and will be of use, but they can have no effects in rendering the deep body of the moss more solid, or more dry. Moss in its natural state is a substance so close and compact as to prevent water from filtrating through it. A partition of unbroken moss, though only a few inches in thickness, will, if not broken by external force, contain water like a cask. If a large basket is filled neatly with a piece of unbroken moss, it may be excavated in the middle to within three inches of the outside, and it will still hold water like a bowl. For that reason I conclude, that deep drains in the moss are of no use, except in relieving the surface of water, and therefore the expence of that operation may be saved.

If the surface is relieved of water as it falls, the moss will soon consolidate to a considerable depth. It is the water standing idle on the surface that sinks into the moss, and renders it soft and loose. When that is prevented, the sun exhales the moisture from the surface. That which is lodged deeper in the stratum is attracted and drawn up by the dry moss above. As the exhalation proceeds, the moss sinks on the surface by

its own specific gravity. When moisture insinuates itself into the body of moss-earth, its volume is enlarged, and it rises higher on the surface; but when the moisture which distended it is exhaled, the moss consolidates, sinks on the surface, and becomes much more compact. The closer it goes together it more readily resists the intrusion of the rain water. If that water is detained on the surface, it will ultimately insinuate itself into the moss. But if a channel stands open at all times to receive and carry off the rain water as it falls, nothing will remain to sink into the body of the moss. In an hour or two after the rain is over, the surface of the moss will be relieved of every drop of idle water, and a few hours of drought will exhale all that had sunk into the moss.

Mr. Tart, who conducts the moss improvements at Castlehead, has made many drains under the soil, and to these he imputes his success in cultivating that moss. It would appear that the Honourable President of the Board of Agriculture had been somewhat of Mr. Tart's opinion. But if they will only remember that a thousand carts of earth, sea-mud, or sand, were put on every acre, and a good dressing of lime applied, they will find that these have had much greater effects in consolidating the moss than the covered drains could have. A pool may be cut and stand full to the brim, within a foot of these drains, and never a drop of that water find its way to the drain.

It will be seen in the subjoined accounts of the improvements made on Strathaven, Garnkirk, and Gartsheugh, Paisley, Hartfield, and Riccarton mosses, and others in Airshire; those at Rednock-house, Duntroon, &c. that no draining has been attempted save the opening of channels for the speedy escape of surface water; and none of these mosses have suffered for want of draining. On the contrary, at Paisley, where a greater number of deep furrows had been cut than is usually done in Scotland, they were found to be hurtful, and were filled up. All the moss improvers that I have met with have owned to me, that they had injured their mosses, by making them too dry, but none ever could say to me that they found any want of drains where no water stood idle or stagnating on the surface.

William Roscoe, Esquire, Liverpool, who was partner with Mr. Wakefield in the improvement of Trafford Moss, (to be afterwards described,) and who is now carrying on the most extensive improvement at Chatt Moss, ever attempted by any man in Britain on that description of soil, had been taught by Mr. Wakefield to make covered drains in the moss, to trench it, plough it deep, &c. in order to drain off the moisture. But he is now convinced that these operations are unnecessary, and he has laid them aside in the culture of Chatt Moss. I cannot better convey his ideas on the subject than in his own words, in a letter I had the honour to receive from him in October, 1807, and which accords with what I saw when I surveyed his improvements in May, 1808.

“ Chatt Moss (he says) is a tract of land of much greater extent than Trafford. The part of it which I have undertaken to improve contains upwards of 3000 statute acres, and lies nearly adjoining to the turnpike road between Manchester and Liverpool. It is now two years since I began this drainage, by cutting a main-road through the middle of the moss, the ditches on each side of which, are about five feet wide, and serve as main drains. From these I have cut other drains at about fifty yards distance from each other, which run, at right angles with the main drain, an indefinite length into the moss; but are intended to serve also as boundaries for the inclosures. In this manner I drained about three hundred statute acres, and found it to answer the purpose. I then met with your Treatise, which induced me to change my plan, as it suggested a mode by which I might accomplish my object, not only with less expence but in less time. I found also the deep drains, (the boundary drains being five feet wide) very inconvenient, as intersecting the land too much, particularly for a sheep pasture. I was therefore induced to try the method which you recommend, which I have since done to very considerable extent, having cut the greatest part of the moss with small drains, about a foot deep, which appears to me, as I can hitherto judge, to answer the purpose as effectually as the longer drains. My workmen even insist upon

“ it that they carry off more water ; but this may appear so
 “ from the water being more confined. In sudden rains they
 “ carry off a great quantity, so that the moss is sooner freed
 “ from surplus water than any other land, and is now passable
 “ in any direction, although it was lately not only difficult but
 “ dangerous to go upon it. If I find by experience these drains
 “ at fifty yards distance not sufficient, I intend to intersect with
 “ others as you recommend.”

The advantage of opening these drains on the surface two or three years before the moss is broken up, is obvious at Chatt Moss. “ Though it had been difficult or even dangerous to go upon it,” as Mr. Roscoe mentions, I saw the plough at work, drawn by one horse, cutting a thin furrow to be dried for burning, on moss more than twenty, perhaps more than fifty feet deep, and where it had been (till drained) as soft and wet as any moss could be. Hence too Mr. Lauder at Rednock House, can plough and summer-plough, again and again, moss that is fifteen or twenty feet deep, which was extremely soft and wet, till the open drains were cut, and the water taken off the surface.

Instead therefore of cutting deep drains, forming covered drains at great expence, or even trenching two feet deep, as Dr. Anderson recommends, I do most earnestly advise all proprietors or possessors of moss, whether they intend to cultivate it or not, that they get it completely relieved of stagnated water on the surface. If it is continued in pasture, that draining, which will cost but a mere trifle, will banish the moss fogs, and improve the herbage to ten times the value of the expence of forming these drains. It will consolidate the moss, render it safer and better for the sheep and cattle that pasture on it, and gradually prepare it for cultivation.

The conviction I feel (after the most mature deliberation, and fullest investigation which I was capable of making) of the unspeakable advantage that would result to the proprietors and possessors of moss ground, and to the nation at large, by surface-draining their moss, has induced me to press upon them that interesting improvement, with the most ardent solicitude. It

appears to me to be a matter of such general interest, as well to merit legislative interference.

But to sum up all on the subject of draining, I repeat, that moss-earth is quite incapable of supporting grain, until its texture is broken, and the moss pulverised into a vegetable mould, by mechanical labour, the vicissitudes of the weather, and operations of manure. That whenever the moss-earth is so reduced, and pulverised into a soil, it becomes so open, light, and pervious, that the water too easily finds its way through it to the under soil, and the sun and dry wind as easily exhale the moisture from it, to such a degree, that it becomes incapable of supporting plants with that indispensably necessary article of their food, a due proportion of water. This being the case, I conclude that all draining, under-draining, trenching, over-deepening the soil, and every operation whatever which facilitates the filtration or exhalation of moisture, or places it beyond the reach of the roots of the crop, are extremely hurtful, and ought to be carefully avoided. Let me also repeat, that the only draining that is necessary for moss, or that can be performed without injuring the crop, is merely to carry off from the surface of the moss all stagnant water. All further draining ought to be guarded against, as the sin of *witchcraft*. Instead of trenching, which has a tendency to render the soil too deep, too light, open and permeable, every thing ought to be done to render it more solid and more retentive of moisture. Mixtures of clay, sand, or any solid earth, manures, rolling when wet, &c. are the operations best calculated to give solidity to the moss soil, make it retentive of sap, and prevent the corns from becoming *witched*.

S E C T. II.

Of Labouring Moss for crops, and the Implements proper to be used.

WHEN the surface of moss has been relieved of stagnant water, it is then rendered capable of being laboured, manured and cropped. In some cases the manure ought to be applied before the soil is begun to be laboured, and in others after that operation. I shall treat of labouring and manuring in separate Sections ; and as one of them must precede the other, I shall begin with labouring.

The mode of labouring may be varied according to the diversities of the quality of the moss, the state it may be in, and the crops intended to be raised.

Hill and bent-moss, being once relieved of surface water, ought, if they are tolerably smooth, to be limed on the sward a year at least before being laboured. But if they abound with inequalities on the surface, these ought to be smoothed before the manure is applied. The surface may be reduced to form either with the plough or spade. When executed with the spade, the soil is formed deeper, and the moss more completely reduced into mould.

The formation of the ridges is by far the most important thing to be attended to in labouring moss. They ought to be formed thirty, or from that to fifty feet broad, raised a few inches in the centre, and so well shaped, that no heights or hollows may remain. If one part of the ridge be raised and another depressed, the crops cannot grow. The heights will fail for want of moisture, and in the hollows, the crop will be drowned. Raising the ridges too high in the middle ought also to be

guarded against †. The furrows in flow-moss, when first broken up, may be a foot wide and fifteen inches deep. But where the moss has a tolerable declivity, or when it has been cropped for a few years, the furrows need not be more than the half of that size. In moss that is very soft and wet, it would be proper to form the ridges at first, from twenty to thirty feet broad, with a furrow between each, and after two or three years, to turn two of these ridges into one.

When bent-moss has been ploughed for the first crop, it is extremely difficult to plough for the second time. The slice furrows of the first ploughing remain entire, and are so tough, adhesive, and so little broken or reduced, that it is almost impossible to plough the field for the second crop. On that account some plough the first year, and delve the second. But I would rather delve the first year and plough the second. By delving the first year, you get the ridges better formed, the surface properly levelled, the soil broken up much deeper, and the tenacity of the moss more completely reduced. When moss is ploughed for the first crop, the *Ket* or fibrous texture of the moss plants covers the plough-irons and greatly retards the labour. By delving the first year that evil is avoided. Delving will cost nearly double the expence of ploughing; but in the course of the three first crops, that may be more than refunded.

Where bent or hill-moss is to be limed on the sward before being laboured, and afterwards to be ploughed, the ridges should be laid off, and furrows opened between each, some time before the manure is spread. This relieves the surface of moisture, and the turf cut from the furrows being laid into the hollows, brings the field to proper form. If inequalities

“ † The Airshire method of giving the ridges a high convex form does not appear to be judicious. I passed through that part of the country in summer 1799, and observed that the crop had failed in the middle of these high ridges, the peat being loose, and parched by the summer drought.”

NASMITH'S Essay on Peat, p. 70.

still remain, they ought to be smoothed before the manure is spread.

Flow-moss must always be laboured with the spade during the first course of cropping, unless it be summer ploughed in the way after mentioned.

When a flow-moss has been completely surface-drained two or three years before being broken up, it becomes so solid as easily to bear the feet of horses during summer. In that case the moss may be ploughed during summer, remain a year or two exposed to the weather, ploughed once or twice, and harrowed the next or second summer, manured with hot lime, and then ploughed, the seed furrow lying exposed to the frosts and rains till cropped next spring. This is the plan followed by Mr. Lauder, who conducts General Graham's moss culture; and it succeeds remarkably well, as will be seen in course. This seems to me the cheapest and most profitable mode of labouring flow-moss. The moss may be three times ploughed in summer, at the expence of one delving, and it is much better to break and divide the moss by repeated ploughings, and to leave it exposed to the vicissitudes of the weather for at least two winters, than to put on a crop before the soil is completely formed.

When this plan of labouring is followed, the operations must be carried on during the summer, as the moss will not support the feet of horses but in time of drought. But when the moss is delved, or where it will admit of being ploughed on, or after harvest, I would prefer that season, that the moss may be first reduced by frost before it is dried into peat. If once moss is completely dried into peat, before it has been soaked with rains and its texture reduced by frost, it does not again so properly melt into a soil, but remains more granulated. This is the only objection that occurs to the mode of summer ploughing that I have been just recommending. The danger, however, is not so great in a spungy open flow-moss as it is in one that makes better peat. And the first ploughing may be executed towards the end of summer, when the drought is seldom of

long continuance, and before the moss is soaked by the harvest rains.

Where the moss is so unequal on the surface, that it cannot be ploughed, it must be laboured with the spade. But after it has been delved, the ridges formed, and remained a year or two exposed to the weather, it may next be ploughed during summer drought, the lime put on, the seed furrow given, and remain to be battered by the storms till seed time.

If the manure cannot be carted on the moss during summer, it may be done during frost.

When the moss will not admit of a harrow drawn by horses, those drawn by men have been used. After the soil has been well pulverised, a harrow of thorns or brush-wood is better than any other. The thorns are fixed to a tree the breadth of a ridge, and do the work very expeditiously. A harrow with iron teeth tears up the turfs, but a harrow of thorns makes the surface smooth.

When moss has been delved for the first year, and a crop taken, some do not delve it for the second crop, but cover the seed by hoeing. Others when they have left the moss exposed to the weather for a season or two, after being delved, and without cropping, put in the seed and manure with hoeing, instead of delving the whole a second time. I would rather recommend delving a second time in the end of harvest, so as the turfs may be well broken by much mechanical labour, as well as better exposed to the frost and rains during another winter before the seed is sown.

The implements used in moss culture are various, according to the taste of those who conduct the operations. In that, as in other branches of agriculture, some continue to use implements but ill constructed and clumsy, while others run into the opposite extreme, forming implements on fanciful constructions, and projecting others that are not, or cannot be formed. Theorists in agriculture, are generally speculators on the construction of machinery and implements of husbandry.

In general, the cultivators of land in Scotland have too few improved implements of labour, and the few which they use

are neither so handsome nor so well constructed as such implements ought to be. But our brethren in England run into the contrary extreme. Our implements are often clumsy; theirs are injured, and much expence wasted, with a fanciful neatness and show. We have too few improvements; they have many more than can be of use equal to the expence which they cost.

The above account of the Scots and English implements applies particularly to those used in cultivating moss. I found at Castlehead, in Lancashire, many implements formed at great expence, and some of them with ingenuity; but I could perceive nothing in any of them that merited notice, or that I would imitate were I to be ever so much engaged in moss culture. Mr John James, who left the situation of an English officer of Excise, to cultivate moss on the Estate of Springkell, brought with him a profusion of spades, hoes, rakes, &c. of many different shapes and sizes; but the only excellence I could discover in them was, that they were agreeable to the fancy of the owner, and afforded him an opportunity of laughing at the clumsy tools used in Dumfries-shire. Those who have succeeded him cultivate the moss to better purpose, with common spades, hoes, and harrows, than he did with fanciful implements, which are now devouring by rust. The labourers from Cambridgeshire carried their fen-ploughs with them to the Ord of Caithness, and laughed at the clumsy implements used in that county. If paring be a proper mode of labouring moss, the fen-plough may do, it is just the Scots flaughter-spade turned into the form of a plough; and its having only one stilt or handle, is merely a local prejudice. A wheel is placed under the point of the beam which prevents the plough from cutting too deep; and the plough irons are constructed to dive into the soil, which the wheel prevents. This renders the plough easy for the ploughman, but the waste of power between the sinking of the plough, and the repulsion of the wheel, renders one of that construction much worse to draw than a swing plough. The greatest improvement I could discover was, a round cutter about sixteen inches diameter, turn-

ing on an axle in the centre. The verges, which are sharp, cut the moss, and by turning round, leave the *Ket* at the bottom of the furrow. The cutter of the skim plough used by Mr. Roscoe, at Chatt Moss, by being placed near the point of the beam, and bending backwards like a corn sickle, seems to answer the same purpose.

Mr. Wakefield, I understand, had expended many hundreds of pounds on constructing implements and apparatus for labouring Trafford Moss. Of these a portable waggon-road of cast iron, to be removed from one part of the field to another, to support horses and carts to put on manure, was probably the most expensive apparatus ever invented for such a purpose. I would rather have carried on the manure to the field, than have transported that waggon road from one ridge to the other, and fixed it so as to carry a horse and cart. It must have been much more costly, and far more unwieldy, than Dr. Anderson's foot paths, made of the boards of an old ship, on which he proposed the horse to travel when ploughing moss.

The late Mr. Fowles, printer to the College of Glasgow, had a plough constructed, to be drawn by a rope over a windlass. But, like Archimedes, who proposed to move the world, he found he wanted a fulcrum on which he could fix his tackle. For when the plough was let into the moss it stood still; turning the windlass only brought it, and the frame on which it was mounted, to the plough, and not the plough to them.

Mr. Nasmith proposes some piece of machinery for squeezing the moisture out of damp moss. Perhaps some body may contrive machinery for grinding or beating it into a pulverised soil, or throwing it into the sea.

The best constructed plough I have ever seen for moss is one used by Mr. Moody, Paisley, with which his servant ploughed, with one horse, in April, 1807, in the space of eight hours, one acre, one rood and nine falls of moss land, the furrows of sufficient depth. In so far as I am qualified to judge, I would not wish for a better constructed plough, or a better day's work.

Rolling is in all cases a necessary operation in a moss soil.

It helps to cover the seed, smooths the surface, consolidates the soil, prevents the drought from penetrating, and preserves moisture. This operation, when it is performed at all, is often neglected till the ground has become too dry. But it should always be executed when the soil is between wet and dry. In that case it bakes the moss into a solid paste, squeezes up the sap, and keeps out the drought. But if the soil has become dry before it is rolled, that operation can do little good. The roller ought to follow the harrow, and the operation should be repeated in the month of May or June.

The roller to be used in moss ought not to be too heavy, nor of a small diameter. The soil is so soft, and rests on a bottom so wet and spongy, that any heavy pressure, or one resting on a narrow space, overdoes the business. The weight sinks the ground too much where the pressure falls, and causes it to burst up behind and before the roller. This rends and shakes the soil, and instead of consolidating, opens it more to the drought, and breaks the tender fibres of the roots of the crop. To prevent these evils, the roller ought to be from four to six feet diameter, that it may rest on a proper extent of surface. And it ought not to be of great weight.

In my former publication, I proposed a roller made of cast-iron. But all of them which I have seen formed of that metal, are by far too heavy for rolling of moss. I would therefore prefer one of wood, about five feet diameter, hollow like a cask, and by no means of great weight. A roller of this kind might be drawn by men where horses could not travel. The horses feet sink so much into the soft moss, that they injure the crop, and leave pits to hold water in rainy times.

To prevent the horses from miring, and the injury done by their feet when ploughing or rolling the moss, Dr. Anderson proposes a portable foot-path, of the boards of an old ship, on which the horse is to travel, and which are to be shifted to new ground every time the plough or roller passes. This seems to me to be an extravagant speculation. A horse may as well be taught to walk on the slack-rope, as to travel drawing a plough on the loose boards of an old ship. When the horse sets

his foot on the one end of the board, it would sink into the soft earth, and the other end of the board would rise against his face. His feet would slide on the boards, and making a false step he would mire in the moss.

But supposing that a horse could be taught to perform, without any accident, this extraordinary exercise, still the expence would far exceed that of delving the moss, or moving the rollers by men. The expence of the horse, plough, boards, driver, ploughman, and three or four men to remove the boards every furrow, would far exceed that of delving the moss with spades. A roller properly constructed might be moved by two, or at least three men, and all the expence of horse, driver, boards, and scene-shifters might be saved.

The ingenuity of projectors too often degenerates into whim. It is rather unfortunate when fanciful projects are introduced into a subject so ill understood as that of moss culture. They tend to disgust the farmers, and rivet their prejudices against that species of improvement. The farmers are not able to discriminate between the improvement and the fanciful project by which it is proposed to be executed. Perceiving the one to be whimsical, they condemn both together. The interests of agriculture have often been much injured, and the prejudices of the peasantry confirmed by the freaks of projectors.

Pattens for horses' feet have been used to great advantage in many parts both in England and Scotland. They are formed nearly circular, or a little oval, and about a foot or fifteen inches in diameter. Some of them have a cross-bar of iron below the hole for the horse's foot, with a hinge joint in the middle; the horse rests his foot on that iron below the boards, and the two halves of the patten clasp on the hoof, with the foot an inch and a half or so through the centre of the patten. Others have the patten entire under the foot, and secured to the hoof by screws, leathers, or chains, which are made fast to the foot. When the latter can be made tight to the foot, they are certainly the best.

SECT. III.

Manuring of Moss Soil.

PRELIMINARY REMARKS.

IN the choice and application of manure to any description of land, the first inquiry ought to be, what is the nature of that particular soil to which the manure is to be applied? what are its properties and defects? what food for vegetation does the soil contain? and is that food sufficiently disposed to solubility, or has it become insoluble and unfit for supplying aliment to plants? Such inquiries as these will be made by every rational agriculturist, before he provides and applies manure at the toil and expence which that article every where costs. It is not enough to procure and apply the substances that go by the name of manure, and that have actually proved such in other instances. Medicine properly and seasonably applied may remove disease and restore health; but no wise man would, on that account, when ailing, run into a Laboratory, and swallow a morsel of the first drug or potion he could lay his hand upon. He would consult with his physician the state of his constitution, blood, humours, and every relative circumstance, and having traced out the disorder, and from what it proceeded, they would not be contented with *drugs* indiscriminately, but make that selection which was found to be best calculated to remove the disorder of that individual. The land Doctor ought to be equally careful to ascertain the state of the soil he is to cultivate, and to apply the manure which, in all the circumstances of the case, is best adapted to that particular spot.

The defect in some cases is a want of that due proportion of the primitive earths which form the best soil. A soil composed chiefly of sand is too open, and not sufficiently retentive of moisture. One composed mostly of clay is too adhesive, and too retentive of moisture. A soil composed of moss alone is too

light and open, and after being laboured, too easily parts with moisture.

But even when the primitive earths are mixed in due proportions, they will not be productive of rich crops, unless they are mixed with a sufficient quantity of vegetable and animal matter, and unless that matter be also in a soluble state. The points to be determined before manure is applied are, whether the soil be composed of such a proportion of the primitive earths as is best calculated to render it productive. Whether it contain a sufficient quantity of vegetable and animal matter : and if that matter be sufficiently soluble. Having ascertained these points, his next care will be to remedy the defects whatever these may be.

If that investigation be made regarding moss, it will easily be seen that that soil is extremely defective in the first and last of these particulars. There is no mixture of earths, for the whole is composed of *one* substance. On the second point of inquiry there will be no want of vegetable matter ; for the whole moss stratum is composed of that alone. But it will also be seen, that the vegetable matter of which the moss is composed is in the most insoluble state in which that substance is found.

To assist the cultivator of moss in the application of manure, I shall offer a few remarks on those following, viz. Top dressing of earth, Dung, Calcareous manures, and burning the moss to manure the soil. The first of these is calculated to remedy the defects in the soil, and will therefore operate as a permanent improvement. The second supplies the vegetable matter so necessary to render the soil productive. The third has no fertilizing qualities, but acts merely as a stimulus in accelerating putrefaction. And the fourth will be shown to be a practice that ought to be exploded. I shall treat of these in their order.

I. *Of Top-dressing of Clay or Earth.*

CLAY, earth, sand, or any solid substance that falls into a pulverised state by the operations of the weather, will, when laid on the surface of the moss, operate as a certain and perma-

ment manure to that soil. Garden mould, or any rich and fertile earth, when it can be obtained, will operate most powerfully at first. But sand, clay, till, rotten rock that falls into powder by the weather, will ultimately answer the same purpose. These admixtures do not contain the fat and fertilizing juices to be found in dung; but they cure the greatest defect in the moss soil, namely, the want of solidity; and prevent it from so easily parting with moisture. And though these substances are steril in themselves, and the moss in its natural state equally so; yet when mixed together, and acted upon by the weather, the clay, sand, &c. is washed into, and mixed with the moss, and accelerates its putrefaction and decomposition, and thereby converts it into manure to the soil.

It is not necessary that the clay or earth be taken from the surface. It will do just as well when taken from the greatest depth. Mr. Nasmith used that taken from the bottom of a pit thirty feet below the surface, and found that it had the effect of changing the herbage into the finest grasses. He also found that slate-coloured schistus, when pounded, had the same effect. Though the earth may be steril when first laid on, the sun and fructifying rains soon render it fertile, and by renewing the putrefaction of the moss, the whole soil becomes fertile. In the application of this species of manure, the only thing to be regarded is, to use that which can be brought to the moss with least expence. In many places that can be done by means of water. The piece of moss reclaimed in that way by the Bishop of Landaff, to be afterwards described, shows in a clear point of view the advantage of that species of improvement. Where that cannot be done, the earth may be carted on the moss in time of drought or frost, or carried on with wheelbarrows.

The quantity applied may be more or less according to the quality of the moss, and the facility with which the earth can be obtained. Solid bent-moss has not much need of an admixture, unless it were a small quantity along with lime, to change the herbage, and to rot the fogs, and convert them into manure. But a soft open flow-moss stands in much greater

need of such a dressing; and on such a soil, the expence is the only thing that ought to set bounds to the quantity.

In all cases, a hundred and twenty, or a hundred and thirty cubic yards of clay, earth, or other substance would form a proper dressing for one acre, and cover it nearly one inch in thickness. The earth, till, &c. is dug from above lime or other rock, and carried to a considerable distance for fourpence halfpenny per yard. That to be put upon a moss would sometimes require to be carried to a greater distance, but the digging would be easier, filling into the barrows the same, and it would never need to be carried up hill, whereas at quarries it is generally carried greatly up hill. In these cases I think the earth may be put upon the moss, at fourpence halfpenny or fivepence per cubic yard. But to speak in round numbers, let it be taken at sixpence: still this dressing may be laid over the moss about one inch in thickness, at or under three pounds per acre. As this is an improvement which would not need to be repeated, and one that is permanent, the expence it will cost need not be grudged. Putting the culture for grain out of the question, this, even for pasture, would be a valuable and profitable improvement.

There are many thousands of acres of moss, in every county of Scotland, where the earth or sand might be floated over the surface, at very small expence. And on thousands more it might be carted, or carried in wheel barrows for two pounds ten shillings, or three pounds per acre. Now I will appeal to any man who knows what a change that quantity of earth would make on a moss soil, if it would not in future be worth from fifteen shillings to one pound per acre in all time coming. If a dressing of hot lime were applied along with the earth, the pasture would be worth from twenty shillings to thirty shillings per acre in all time after. If so, what species of manufacture will bring such a return? The surface may be relieved of stagnant water for about ten shillings per acre. Say the clay costs three pounds; a good dressing of lime may be spread on the field for less than four pounds; but say that the whole cost eight or even nine pounds, and that it rented for no more in

future than one pound per acre, still the improver would have ten or eleven per cent. for his money, while a purchaser would be content with one-third of that return. How fortunate would it be for themselves, as well as beneficial to the public, if the proprietors of such land, instead of laying out their money in new purchases at twenty-seven or thirty returns, would expend at least some part of it in improving what they have, from which they might, instead of three or four, draw from ten to twenty per cent. of the money so advanced. If proper understanding could be kept up between the proprietors and tenants, a few acres might be reclaimed in that way every year, in time of frost or drought, at no material expence to the tenant, and each of these acres would be equal to one pound per annum, at least to him during his lease, and as much to the proprietor in all time coming. But these things are altogether over looked by the proprietors, and the tenants choose rather to spend the time they might devote to such improvements in sauntering at Fairs, Races, Rousps, Weddings, or about Mills or Smithies, collecting the news of the neighbourhood; or perhaps at Curling, where neither the body nor mind can be improved, and where the amusement is silly and trifling.

Improving of moss with earth, sand, &c. does not rest on opinion: it has been carried into effect at Trafford moss, Castlehead, Garnkirk, and others that will be detailed in the sequel. And in all cases it has been found to be a substantial, a profitable, and a permanent improvement.

I am not of opinion, however, with Mr. Nasmyth, that moss cannot be rendered fertile without an admixture of earth, sand, &c. which he terms "adventitious substances." On the contrary, I know, that much more moss has been improved without such admixtures than with their help, as will be seen in course. Till within these last two years, no earth has been put on Strathaven moss. Scarcely any on the mosses that have been reclaimed in Airshire, Renfrew, Argyll, &c.

Burnt clay, it is well known, acts as a powerful manure on a moss soil.

Means might certainly be taken up for roasting (or torrify-

ing, as learned and fashionable agricultural writers term it) clay as a manure to moss. Where lime cannot be obtained, and coals at a great distance, the clay might be roasted with peat for manure to the moss, or even for clay soils, for which it is also an excellent manure. It consolidates the moss soil, accelerates its decomposition, and raises rich and sweet grasses.

A strong clay soil, either mixed or covered with a quantity of dead torpid moss earth, is often found on the sides of moors and mosses. That description of soil is of a black colour, and what the country people call *deaf*, much disposed to heave on the crowns of the ridges, with nothing towards the furrows, but a cold tenacious clay, incapable of producing grain. The greatest improvement of such a soil would be, to dig up and dry the whole peat-earth which it contains, and, having mixed it with as large a portion of the clay as it could burn, to set the whole on fire. This would relieve the soil from that useless torpid peat-earth, which the most powerful manure could scarcely render soluble; and the burning it with the clay, would enrich the latter so much, that the soil would be greatly improved in its mechanical arrangement, and much more productive for many years to come. If the quantity of moss in the soil should be inadequate to calcine a considerable portion of the clay, it might be proper to add a quantity of fresh mess for that purpose. I remember to have seen a ridge of land, composed of a mixture of dead insoluble moss, and cold unproductive clay, set on fire by accident, in the beginning of summer, when extremely dry. The ridge burnt till the peat-earth was completely consumed, and a large portion of the clay with which it was intermixed was calcined. The proprietor thought the ground was lost, but he was happily disappointed. The soil was so much enriched by the burning, that he found it his interest to dig up, dry, and burn the whole field. In burning soil of this description, the utmost care should be taken to conduct it in as smothered a way as possible, in order to preserve the vegetable matter from being dissipated in gas.

As the burning here recommended must divest the soil of vegetable matter, it will be proper instantly to replace it. If dung cannot be found, moss mixed with hot lime, or with dung,

to render it soluble, should be applied ; tares might be sown and ploughed down, or whatever other means may be found to be best calculated to replace in the soil a due proportion of vegetable matter, of which it had been divested by the burning. It may appear strange at first view, to propose to burn up the moss already in the soil, and to replace it with another quantity of that earth. A little reflection, however, will show the propriety of the measure. The moss in the soil proposed to be burnt, will be found to be much more insoluble than the common moss : so much so, that it would exceed even the powers of caustic lime completely to dissolve it. Burning not only removes the worst of all moss, but it also enriches the clay, and corrects its greatest defect ; while the new moss recommended to be applied, having been rendered soluble by fermentation with dung or hot lime, will prove a rich manure to the soil, and replace in it the vegetable matter which had been burnt. The burnt clay, and the change which it will effect in the mechanical arrangement of the soil, will greatly promote the putrefaction and decomposition of the new applied moss. By such means, the barren fields situated on the verges of the mosses and moors, might be rendered fertile at a small expence.

As I have frequently taken the liberty of quoting Dr. Anderson, when I conceived he was in an error, it is but justice to his general merit, to pay him that compliment when I am satisfied that he is correct. He says, p. 104. " Rich clay, where
 " it can be had at moderate expence, when laid upon the sur-
 " face of the moss land in considerable quantity, gives to the
 " soil the solidity it naturally wants, and renders it much
 " more susceptible of culture as arable land, than it otherwise
 " would have been."

" If that clay be blended with a small proportion of the
 " moss, and burned in clumps till the clay be reduced to a
 " gross powder, a process very easily performed : I have been
 " assured that if, in this state, it be laid upon the soil, it pro-
 " duces a still more beneficial effect than the simple clay alone :
 " not only on account of the alkaline matter, though in small

“ proportions produced from the ashes of the peat when burned in the slow manner that necessarily takes place in this case; but also from the sharp solidity of the burned clay, which acts powerfully in reducing the peat to a firm and compact state.”

Mr. Nasmith concurs in the same opinion, and proves his doctrine by experiments in flower pots. I cannot, however, agree with that intelligent agriculturist, when he advises the burning of the soil of the cultivated field of moss, on which some earth has been laid, merely to get that earth torrifed, as he calls the burning. After a steril field of moss has been laboured, manured, cropped, and formed into a productive mould, it would, in my opinion, be as absurd to set that soil on fire, merely to torrify the little earth that had been put on it, as it would be for a farmer who was in need of manure to torrify his house and offices for the sake of the ashes. He proposes to turn over the soil, that is to plough or pare it, in the beginning of summer, and set it on fire when dry. The fire he thinks would eat along the surface, without penetrating deep. In this, however, he is mistaken. The fire, if heavy rains did not come to extinguish it, would burn even the wet moss under the soil many feet deep. I have seen a moss set on fire, but when once kindled the fire could not be extinguished till rains put it out. I have seen holes burnt in the damp moss six feet deep. He thinks, that from the wet moss below checking the progress of the fire, it would be converted into charcoal, and not into ashes. He is certainly correct in that opinion, if he mean (as I suppose) that the moss would not be burnt completely into ashes, but much of it remain a sort of charcoal or cinder. But this, instead of being an argument for the burning he proposes, affords the most satisfactory evidence that it is injurious.

The ashes of peat have some effects as a manure, but the cinders of peat are unfit for either a manure or for a soil. If mixed into a strong clay soil they might do some good in opening the pores of the clay, and making it less tenacious; but even there they can yield no food to plants. They are nearly

as insoluble as sand. This is one reason for rejecting the burning of moss as will be shown in its proper place.

But there cannot be a stronger argument against the practice under consideration, and to show the total insignificance of these cinders, than from Mr. Nasmith's own experiments, as detailed, p. 57, of his *Essay*. He had peat burnt, and the ashes being put into water, he mixed that which floated on the surface into one pot, filled with river sand, and the heavy matter or cinders that sunk in the water into another pot of the same sand, planting a grain of oats in each; that planted into the pot of sand mixed with the ashes which swam on the surface of the water, sent out eleven, while that in the pot mixed with the cinders put forth only seven stalks. The roots of the former had ramified through the ashes, and derived their support from them, but the plant in the other pot had derived no nourishment from the cinders, but had subsisted on what it could collect from the sand, and on some rich mould adhering to the sides of the pot.

For these reasons, I disapprove of burning any moss as a mode of manuring the soil, more especially after the soil has been mixed with earth and cultivated.

II. *Of Dung as Manure to Moss.*

OF all the species of manure yet discovered, dung is the most valuable. To whatever soil it may be applied, it never fails to give the most speedy, certain, and ample return. It is also the most powerful and efficacious manure to a moss soil.

Dr. Anderson, however, disputes its use as a manure, and asserts, page 103, that "Dung is a manure not adapted to the nature of moss land, until the moss be converted almost entirely into the state of earth, having lost nearly the whole of its inflammability."

John Smith of Swinridgemuir, Esquire, in page 9th of the Account of improvements of moss on his Estate, says "That dung without lime is found incapable to reclaim moss; that

“dung even with lime, when applied otherwise than with a potato crop, does not answer near so well.”

I am confident that these Gentlemen have greatly misunderstood the value and powers of dung as a manure to moss. Had they made proper trials themselves, or duly attended to those made by others, they would have seen that dung is a rich and powerful manure to moss as well as to other soils.

The efficacy of dung as a manure is as conspicuous on moss as it is on any other soil; and that in every state in which the moss is found. Its effects are more speedy and more certain than those of any other manure. It will raise a tolerable crop of grain on a moss the first year after it is broken up, which cannot be done with any other manure.

Strathaven Moss, to be afterwards described, has for half a century past, yielded good crops, and for the last twenty or thirty years has produced more grain than twenty times the average of the whole arable land in the county of Lanark, and three times as much as the richest land on the Clyde, and till within these last two or three years no other manure but dung has been applied. I have had five bolls per acre on deep moss, delved for the first time in January, and sown down in April thereafter; the dung put on with the seed, and no other manure given, of preparation made; and I have seen others raise crops still better for the first year with dung alone. Mr. Menzies in Gartloch has always used dung alone as manure; and on the wettest and softest of flow-moss, composed almost entirely of sphagnum little decayed, he has had five or six bolls for the first, and ten bolls per acre for the second crop, with no other manure but dung.

Dung not only communicates fertilizing matter to the soil, but it brings on putrefaction on the moss, and thereby converts it into manure, or the food of the crop. The value of dung as a manure to moss, and to every other soil, is so universally known, that it is unnecessary to say more on that subject.

Wherever lime or any other manure which may be multiplied at pleasure can be obtained, it ought to be applied to the moss, and the dung preserved for the other land. But as lime

does not act powerfully at first and so speedily on flow-moss, or on that which has no green sward, and as dung raises a crop the first year, and soon brings the moss into a green sward on which lime can act, I would advise every cultivator of moss to apply some dung, if it can be obtained, to all flow-moss when first broken up. I do not say that flow-moss cannot be rendered productive without dung; but I am certain that of all other manures the dung makes the speediest and best return on that species of moss.

Wherever a moss is covered with a green sward, however coarse, and whether that sward may be the natural growth, as in the case of bent moss, or if it may be artificial, in consequence of some top-dressing, or other cultivation, lime is the most proper manure. And if the farmer have any other use for the dung, it would be bad economy to apply it to such moss. But when the moss has no green sward, but is only covered with heather and fogs, as in the case of flow-moss, or if it want herbage altogether, in these cases a dressing of dung becomes necessary in the first instance to raise a crop or two, and bring the moss under a green sward. Lime ought to be applied along with the dung; but without some dung, the lime will neither raise a crop so speedily, nor so soon bring on the green sward wanted. If dung cannot be obtained, a little earth or sand will do much good along with the lime; and if neither of these can be applied, the lime alone will ultimately bring the moss into a productive state, though not so speedily as the dung.

When dung is applied to moss newly broke up, and in all cases where it is applied after the moss is laboured, it should be either spread on the ground in the end of harvest, so as it may be washed into the soil before the winter frosts come on, as they are supposed to injure dung when too much exposed to them: or if that cannot be done, the dung may be carted on the moss, and laid in heaps during the frost, and spread whenever it is completely out of the moss. If it be spread at the commencement of the thaw, and before the soil is opened, the rains would wash off the best juices of the dung, and if the

moss remained frozen, it could not sink into the soil, but would be carried off by the water and lost. But the sooner after the complete thaw that the dung is spread, the better, as it is washed into the soil before seed time, when the sun has not power to exhale its richest qualities. And when the harrow comes over the field, it breaks the knots of dung, gives them a new position, and mixes the dung into the soil.

The cultivators of Strathaven Moss have always put on the dung after the seed, and before the ground was harrowed. But that is the worst time that dung can be spread. The seed time is the driest part of the spring. The sun has by that time of the season become able to exhale powerfully from the earth, and with the aid of the winds soon carries off the richest qualities of the dung when spread on the surface, and not covered up, leaving nothing to the soil but a *caput mortuum*, dried like a piece of cork. The simple cultivator is too often content with the dead body of his dung after the substance is gone. All that some farmers regard anent their dung is bulk. They expose it in the dung-stead and on the field to the sun, wind, rains, frost, and every change of weather, without the least regard to the loss of vegetable food which it thereby sustains. As long as the *bulk* is not diminished, they let the rains wash away, or the sun exhale what they can. They generally suffer the same privations as to the richest qualities of hay. If they can rear up a hay stack of sufficient bulk, no matter to them how little of the nutritive qualities of the hay remains.

Urine, as an appendage of dung, ought to be more carefully attended to than it has generally been. The volatile alkali with which it abounds, would, if duly preserved and rightly applied, act powerfully on a moss-soil. The food of plants which it contains would be preserved, while by the present mode of treating that article it is lost, and the urine would accelerate the decomposition of the vegetable fibre in the moss-earth.

Other substances may be found that would act as manure to moss, or increase the volume as well as the value of the dung;

but the great thing wanted at present is to excite, among the occupiers of land, a diligent use of what is already known.

III. *Calcareous Earths.*

CALCAREOUS matter, in every shape in which it has been found, may be formed into a powerful manure to moss, in every state in which it is met with ; and to every soil that abounds with vegetable matter in an insoluble state.

Calcareous earths do not contain any substance on which vegetables can feed ; but rather are in themselves poisonous to vegetation. They act merely as stimulants. They accelerate the decomposition and putrefaction of the animal and vegetable matter in the soil, and convert them into the food of plants. It is in that manner that they enrich not the soil, but rather the present crop at the expence of the soil. Hence it is, that when calcareous manures are too often repeated, in a soil not over-stocked with vegetable matter in an insoluble state, they fail of producing crops. If the soil is destitute of vegetable and animal substance, or if that which it contains has been exhausted, the calcareous earths can find nothing to act upon, unless they burn up and reduce the growing crops. But where the soil abounds with vegetable matter, and that matter not much disposed to go into putridity, the lime, or other calcareous earth, when applied in a caustic state, will hasten putrefaction, reduce the vegetable matter, and convert it into the food of the growing crop. This is the principal effect produced by lime. But it also changes the mechanical arrangement of the soil. It opens the pores of a tenacious clay, and binds together a soil that is too loose ; and it attracts moisture from the atmosphere.

That these are the effects which lime when used as manure can produce, no one will dispute. If so, no manure can be better adapted to a moss soil than lime, or any other calcareous earth. Moss not only abounds with, but is wholly composed of vegetable matter, which like other decayed herbage, contains the very richest food of growing plants. But that food is placed

beyond their reach, by the antiseptic quality of that vegetable matter. For it is only when decomposition of vegetable matter is going on, that growing vegetables can collect food from that substance. The moss, though composed entirely of vegetable matter, is not, in its natural state, disposed to yield any thing to the growing plants. That which would enrich them is locked up by insolubility, and remains dormant in the torpid moss-earth. Lime or any calcareous manure dissolves that charm, renders the vegetable matter soluble, sets at liberty the vegetable food which it contained, and which had, till that stimulating manure was applied, been kept latent by the antiseptic and insoluble qualities of the moss. Lime and every other species of calcareous earth must therefore be a powerful manure to a moss soil.

Calcareous substances are found in the mineral kingdom of nature, in various shapes and states of combination. All of them are calculated to operate as manure, but they act more or less powerfully according to the quantity of calx or lime which they contain.

Gypsum is of all others the most powerful of the calcareous genus of fossils. This species of manure, which is sometimes called Alabaster or Stucco, Plaster of Paris, &c. is a calcareous earth, abounding with vitriolic acid, and is soluble in five times its weight of water in the temperature of sixty. It possesses extraordinary septic powers, and accelerates putrefaction more powerfully than any other substance can do. Five hundred weight of raw materials from the quarry, when reduced to powder, and sown upon the surface, in January or February, will completely dissolve the grass and vegetable matter on the soil, and melt them down to the food of a new crop. It greatly promotes the growth of clover, pulse and corn, and is certainly the most powerful manure for a soil. This valuable manure was discovered about anno 1769, by Mr. Mayer, a German clergyman, and it is now very much used over all Europe, and America. It probably does not very much abound in the western parts of Scotland, neither has it been much sought after there. But it is to be found in great abundance both in

England and Ireland, and is usually sold at the quarry, at two shillings and sixpence per hundred weight. And as five hundred weight of it is a sufficient dressing for one acre, and that quantity can be obtained for twelve shillings and sixpence, it will be found to be the cheapest, as well as the most powerful of all manures. But it is unfortunately very little known or sought after, in this part of the country.

Quick-lime is, next to Gypsum, the most valuable and powerful manure known in Scotland for a peat soil. It seems to have been formed by the Creator, to remedy every defect in that species of earth. It powerfully promotes the putrefaction of the vegetable matter of which the moss is formed ; breaks its cohesion ; acts powerfully on the acids in the peat earth ; and forms with them a neutral substance, which has powerful fertilizing effects ; strongly consolidates the moss soil ; banishes the heath and coarse plants, and covers the moss with clover and daisies. Dr. Anderson very properly remarks, that the effects of lime or other calcareous matter, when applied to moss in sufficient quantities, appear to be little short of enchantment. If lime, or other calcareous substances are laid on the sward, though the land be neither laboured, nor any seed sown, such are the effects of hot lime, that the moss plants will instantly disappear, and a rich and beautiful sward of clover, daisies, and the richest poa-grasses will rise spontaneously. As the greatest part of the moors in the western counties of Scotland abound with lime and coal, and as many of them also contain vast treasures of marl, the reclaiming of the mosses in these districts will become an easy matter, whenever the proprietors and possessors shall be disposed to turn their attention to that improvement. It has already been mentioned, that when lime is applied to a rough benty sward, it should be allowed to remain a year upon the ground before it is ploughed, and if another small dressing of hot lime could be applied to the moss, whenever it was laboured, it would render it much more productive. That laid on the sward, in a caustic state, a year or so before the moss was broken up, would reduce the coarse herbage on the surface, bring it into putridity, and form it into the food of a crop.

And that thrown on when the moss was laboured would encounter the acid in the soil, which is injurious to vegetation, and is one of the ingredients in moss which resists putrefaction, and would reduce it, with the alkali in the lime, to a neutral salt, which greatly promotes vegetation.

The lime laid on the sward cannot have reached the moss nine or ten inches below. That ought to have its manure as well as the surface. The sooner it gets that manure, the more effectually will it operate. If once the acids in the moss are washed away, or reduced by any other power, the lime will not get them to act upon, and of course that neutralized matter will not be formed. If the coarse herbage on the surface be reduced by the lime laid on the sward, some months before it is laboured, and the acids in the moss neutralized, by another dressing of the same substance, a double portion of vegetable food will be provided. The moss-earth, thus beset above and below, will be subjected to putrefaction, and forced to yield up the substances of which it is composed to be employed in rearing a new crop. Even when its caustic powers have been exhausted, and the lime has become effete, it will help to consolidate the soil, and promote the growth of plants, by attracting the aerial fluids.

To give lime its full effects on a moss soil, it ought always to be applied when nearly slacked, and in a powdery state. If it has been saturated before it is applied to the soil, it does not act near so powerfully either in reducing the coarse herbage on the sward, or in uniting with the acids, as when it is applied hot and powdery. When it is not spread before it becomes effete, it does not mix with the soil, but remains in lumps like pieces of chalk.

Lime that has been saturated, and gone into the state of chalk, may be renewed, and rendered powdery by being mixed with unslacked shell lime, or by burning it anew.

I have mentioned under the preceding article, that where the moss is covered with a sward of green herbage, whether fine or coarse, lime is the most proper manure that can be applied. But where there is no such herbage, as in the case of

flow-moss covered with heather and fogs, or that which has no herbage at all, a little dung or earth along with the lime would be necessary. Lime will ultimately bring the moss into a productive state, without any manure; but dung will render that description of moss much sooner productive than lime alone. After a sward of grasses has been raised over the flow-moss, by any means whatever, lime then becomes the most proper manure.

There is sometimes much difficulty in getting the lime spread on the moss. It can easily be carted on bent-moss, but flow-moss is too soft to carry horses and carts. As that species of moss should always be delved into ridges, one or two years before the crop is sown, the lime may be carted on in time of frost. It will seldom happen that two successive winters are so open as not to render a smooth delved moss fit to carry horses and carts. If the farmer is engaged in carting during the frost, he must carry on the lime with wheel-barrows on deal roads at some other time.

Mr. Nasmith, in the Essay so often referred to, discards lime as a manure to moss, and says, that soil cannot be rendered fertile without a mixture of solid earth. He seems to have taken up that idea, from experiments which he had made with moss and lime in flower-pots, which he details in his Essay.

I have already stated objections to flower pot experiment. A pot eight inches deep, and eight inches wide, bears no fair proportion to a field of moss. His pots were placed in his garden at Hamilton, or under the breathing of a cow, and he watered them every evening. Fields of moss cannot be placed under such advantageous circumstances. They cannot be brought to the vale of Clyde, or so near the level of the sea. They can neither have the benefit of a wall to reflect the rays of the sun, the breath of a cow, nor the fostering hand of an intelligent cultivator, and man of science, to pour on them diurnal libations of fructifying moisture.

But supposing there had been a greater coincidence of relative circumstances, the experiment on which Mr. Nasmith

founds his conclusions, was extremely erroneous, in the proportions of soil and manure, on which the experiment was made. In one experiment detailed, page 61st, he mixed three-fourths of moss with *one-fourth of quick lime*. In the other he took five-sixths by bulk of moss, and one sixth of newly slacked lime ; and because he did not find the corn thrive in either, he thinks it deducible as an obvious corollary, that lime is not capable, without some other mixture being added, of rendering peat-earth soluble in water ; or, in other words, that lime alone does not act as a manure to a moss soil. But why use such an undue proportion of hot lime ? Nobody ever thought of having one-fourth, or even one-sixth of the soil hot lime. A moss soil ought to be at least one foot in depth. If three inches of that soil were hot newly slacked lime, and the seed instantly placed in it, nobody could expect the corn to grow with health and vigour. This would be liming at the rate of *five or six thousand bolls per acre*, which is more than *fifty times* a proper dressing, and sufficient to burn up every green thing.

The same author in his Elements of Agriculture, page 101st, when treating of the proper mixtures of soil, says " When the " proportion of lime exceeded one-tenth, it appeared rather " to retard than to forward vegetation."

Mr. Nasmith says, that moss mixed with lime proves a good manure to other soils. This can happen no other way than by the lime reducing the acid in the moss, and bringing the moss itself into putrefaction. If so, it must have the same effect when the lime is applied to the moss as a manure. He says, that the moss which had been mixed with the lime, and on which he made the experiment, was converted into *a fine friable mould* during three or four months it had been in the pots. Was not this a proof of the dissolving powers of the lime ? And if the lime can reduce the fibre, and organic texture of the moss, as it certainly will do, no doubt can remain but it will act as a manure.

I might quote Dr. Anderson, who says, that calcareous manures produce effects on moss little short of enchantment. But passing over that and some other written authorities, I shall

mention a few instances where the effects of lime, as a manure to moss, is proved by experiments on much broader bottoms than flower-pots.

Mr. Leeper of Drumbowie, and others on that farm, Mr. Knox of Letham, his tenant James Peat, John Loudoun, and others in this parish of Avendale, have raised fine crops of good oats on moss of different kinds, with lime, and nothing else as manure.

Many hundreds of acres of mosses, bent and flow, have been reclaimed in the county of Air with lime alone as manure. Nothing else has been applied to the mosses in Grougar, those on the Estate of Glassnock, Riccarton Moss, Montgreenan Moss, all in that county, to be all afterwards detailed. And I could point out hundreds of other instances, where the same thing has been done in that county. Many hundreds of acres have been rendered fertile at Duntroon, by lime alone as manure. The same thing has been done at Rednock House, both afterwards described. And one would have expected, that Mr. Nasmith should have discovered, that his own tenant, Colin Brown in Drumloch, raised the richest crops of corn, hay, and grass, on deep moss on that farm, with lime as the only manure.

Marl has been used as a manure to moss with great success. It has been the chief manure used at Trafford Moss, and it is almost the only manure now using by Mr. Roscoe, in the improvement of Chatt Moss. Marl abounds in many of the moors and under the mosses in all the counties of Scotland; but is very seldom duly attended to. It is known to abound in some of the moors in the parish of Avendale, yet so inattentive are the proprietors of land and their tenants, to these sources of wealth, that these valuable treasures still remain unbroken. A proof that Agriculture has not yet been much attended to in that part of the country. The inexhaustible treasures of lime belonging to the Duke of Hamilton, in that parish, were only opened in 1807, and there has been as much lime used as manure in that parish, since these quarries were opened, as had been so used for several centuries before.

IV. *Burning of Moss as Manure.*

To BURN some part of the moss with a view to enrich the soil, by the ashes of what is burnt, is bad economy, and ought to be abandoned. The Earl of Dundonald has shown, that when moss is burnt in the open air, nineteen out of twenty parts of what it is composed of, are dissipated in gas. That which remains is so small in bulk, that the whole ashes of a ton of moss, when separated from the cinder, may be stowed into a Highlandman's snuff-mill. Even that insignificant quantity, does not possess much fertilizing matter. The small quantity of alkaline salts that remains, may raise a crop or two; after which the moss is doomed to perpetual sterility.

Dr. Anderson indeed says, that "flow-moss produces a great deal of ashes, which are usually red and heavy." But in so far as I have examined into the ashes of peat, I never found them either bulky or weighty, unless the moss was mixed with earth, or some other substance; and in that case it was not the ashes of moss, it was that of some other admixture. But of all the kinds of moss which I know, that of flow-moss has the fewest, the lightest, and the whitest ashes. The red colour proceeds from the oxide of iron; but that oxide does not abound in moss, unless when carried on it by water into which it is mixed. At any rate, it is not found in flow-moss, the ashes of which are generally white, and so extremely light, that they are mostly blown up the smoke funnel, or through the room in which the peats are burnt.

The only case in which I would think the burning of moss justifiable, is where the hags or gullies are deep, and the knolls or hillocks between them have become too dry for being cultivated. These hills can be levelled, but the moss that has been dried for many years, does not easily melt into a soil, and the loose broken moss thrown into the gullies, to bring them to a level, would not retain moisture to support vegetation. In that case it might be proper to burn off the top of the hills, having first dug them up and rendered them completely dry, and then

cultivate the moss farther down. This I do not consider to be burning for manure, but to get quit of bad moss, and come at that which is better.

It sometimes happens that the best moss is uppermost in the stratum. This is always the case where a loch or lake has grown up with the coarse bulky plants that rise in such situations, and then flow or bent-moss is formed over the lake-turf. In that case it would be ill judged to burn the best moss, to get at that which is worse.

If moss is of a bad quality, of a moderate depth, and covering a subsoil of clay or good earth; in that case it might be proper to burn the moss, so as to come at the richer soil below. If that subsoil was a close adhesive clay, the ashes of the burnt moss, or even of some of the roasted clay along with the moss, would open the tenacious clay, and render it more fertile. I am of opinion it would be proper to burn about a foot of the moss at Blair Drummond, with some part of the clay below, rather than float off the whole, and then cultivate the cold tenacious clay.

If the moss rests upon rock, rotten rock, gravel, or steril sand, burning would be the greatest folly; as the moss is a much better soil for cultivation than that which it covers.

When burning of moss is attempted, the utmost pains should be taken, to dig it up, have it well dried, and burnt as completely as possible. When kindled before it is dry it does not burn freely, but singes, and a large portion of it is not completely reduced to ashes, but remains in cinder or char. Nothing can be more insoluble than charred peat, or peat cinders. Even moss that has been once completely dried into peat, cannot be easily reduced to a soil. When charred it must be still worse. Moss that is black and viscid is more readily formed into cinder than that which is open and fibrous.

The English moss improvers are, in my opinion, too fond of burning part of the moss to form it into manure. But they always first pare up what they intend to burn, dry it well before they kindle the fire, and burn up the greatest part of what has been cut: this leaves but little char. But in Scotland, the

moss is set on fire without being dug up or dried, and in that case the fire singes and eats in till it is extinguished by rain, so that the extent of the burning is entirely regulated by the state of the weather. A considerable quantity of the moss is not burnt but converted into coke or cinder, which can never be again formed into mould ; but remains as insoluble as so much water gravel. It is even worse than sand or gravel of the same size ; for it is equally insoluble, and so extremely light and open, that the drought penetrates, and the water escapes easier than into gravel. It is like the shavings of cork.

The Earl of Dundonald, adverting to the dissipation of the peat into gas when burnt in the open air, recommends the burning of it in a smothered way. But by avoiding one evil we often run into another. If less of the vegetable matter went off in gas, more of the moss would be converted into cinder or coke, if it were burnt in a smothered fire. Even when the peats are dried and burnt in a grate as fuel, much of the peat runs into a char or cinder, and continues to singe or burn in the ash-pit for a long time. This is owing to the small ashes like snuff smothering the fire before the peat is entirely reduced. If the ash-pot were filled with water, to extinguish the fire as the ashes fell from the grate, nine-tenths in weight and bulk of these ashes would be coke or cinder, which would sink in the water, and the real ashes that floated would be very small. The proportion of charred moss must be still greater when the fire is kindled in damp moss, or combustion smothered.

The advocates for burning say, that it consolidates the moss. This is true. It converts a part of the moss into coke or cinder, through which the water percolates, and which are on the soil the same as river sand, but lighter.

Moss that has been burnt will yield one great crop, and one of an ordinary value, but it will never again yield any more from the effects of the burning, and not near so much when manured and treated otherwise, than it would have done if the moss had never been burnt. Even when laid down to grass, the moss that has been burnt does not long remain covered with rich grasses, but soon becomes bare in places here and there, and

yields few plants but the *Bryum Purpureum*. Wherever you find that plant growing on moss, you may conclude, that some part of it has been burnt; and you will uniformly find it on all mosses that have ever been burnt. Wherever you meet with that Bryum, if you examine the soil, you will find in it the granulated cinder of moss that is ill burnt and void of moisture. That plant never grows but on places where useful herbage cannot grow for the want of moisture. It is found on the walls of old buildings, parapets of bridges, among the lime and sand fallen from an old building, on the sods laid on the top of a stone dike, &c. If a plant that grows in such places as these be found in a moss, it shews that the soil is too dry.

I have seen some of the cultivators of Paisley Moss trench that which had formerly been burnt, merely to get quit of the *Bryum purpureum*. This plant is of a red colour, and resembles the strong hairs that grow on a man's beard, or short stout bristles on a sow, having a small knot of seed on the top of the stalk.

S E C T. IV.

Crops proper for Moss-soil.

EXPERIENCE has shown, that a cultivated moss-soil is capable of producing, in great perfection, grain, roots, and grass in almost all the varieties in common use. I shall mention the plants that have been raised on moss, or such as I think might be raised on that soil, classing them as under, viz.

1. WHITE CROPS.

2. GREEN CROPS.

3. GRASSES, &c.

1. *Of White Crops on Moss.*

Wheat will grow on moss as well as on any other soil. Ex-

cellent wheat has been raised on Trafford moss, at Castlehead, at Gartsheugh, near Glasgow, &c. The crops were bulky, and the grain excellent. The only difficulty is with the frost throwing out the grain in the spring. Rolling is the best antidote, but if the spring is frosty it will not be easy to preserve the wheat in the ground.

Oats are the chief production of moss; and many fine crops of oats have been raised on that soil, as will be seen when I come to describe the improvements in different parts of Britain. The *earliest* oats should be preferred, and they ought to be sown as early in the seed time as possible; both to secure an early crop, which is always the best on a moss-soil, and also to catch the soil between wet and dry. If the moss be very dry when the seed is sown, unless rain comes soon, the brand will not be equal, and the crop will do little good. Moss dries sooner than any other soil, and the earlier it is sown the better chance is there of a crop.

Barley and Beer have been often sown on moss, and yielded great returns. They have been tried in all parts of Scotland, and in all the improved mosses in England, which I have seen, and have done well in both kingdoms. I found some good beer growing on the moss improved by Sir John Sinclair, on his Estate of Langwell, near the Ord of Caithness.

Rye has been a common crop on moss in England, and in some of those in Scotland. At Scaleby Castle in Cumberland, rye sown on moss yielded sixty returns.

2. Of green Crops on Moss.

Potatoes grow to great perfection in moss, and many fine crops of that valuable root have been raised in that soil. It is more than a century since that excellent plant was raised on the mosses in Ireland, and it was raised on moss in Galloway more than fifty years ago. Since the cultivation of moss as a soil has begun to be attended to in Britain, the raising of potatoes has been better understood. They were first planted in the lazy-bed form; but it is much better to delve the ground,

and plant the potatoes in drills, with dung. When planted in beds, the soil is not formed of sufficient depth, and the after-crops are never good. But when the moss is first delved, and the potatoes planted in drills, the soil is formed of proper depth. The planting, hoeing, &c. break and form the soil, and the shaws of the plants overshadow the ground, and rot the moss into mould. Potatoes have been a common crop wherever moss culture has been attempted; the extraordinary produce at Paisley Moss, will be mentioned when those improvements are described.

Turnip is a plant well adapted to a cultivated moss-soil, and many crops of fine turnips have been raised on moss in all parts of Britain where moss culture has been attempted. To mention instances would be endless. I found them on the mosses in England, and in Caithness, as will be seen in course. The mode of planting and raising them in moss, is the same as in dry land. The tap root of the turnip is well adapted to a moss-soil, which is apt to become too dry in time of drought; and its broad leaves overshadow the ground, and promote the decomposition of the moss.

Peas have been sown in many different parts of Scotland, and in England, on moss ground, and some excellent crops obtained. They have often in wet seasons turned out a poor crop, but the same thing frequently happens on dry land. They have a powerful effect in rotting the moss, and securing a good crop of oats or wheat next year.

Beans are well adapted to moss ground, and some valuable crops of beans have grown on that species of soil. I saw as fine beans as ever grew, that had been raised on Trafford Moss. The tap root of the bean goes deep into the soil beyond the reach of the drought.

Carrots grow amazingly on cultivated moss. It will be seen in the account of the improvements at Castlehead, that the carrots were worth *seventy pounds per acre*, yielding forty-nine pounds weight on the square yard; some of them three feet long and eleven inches round at the neck. Carrots ten inches and a half round at the neck were raised on a deep flow-moss,

cultivated by Lord Glenlee, near his Lordship's seat of Barskimming, in Airshire.

Parsnips would certainly grow well in improved moss, though I do not know of their ever having been tried in that soil, save when it was turned into a Garden, and there they were excellent.

Cabbages, *Greens*, and *Cauliflower* have all been planted in Paisley Moss, and excellent crops obtained.

Coleseed grows well in moss. I found it growing luxuriant on Sir John Sinclair's moss, in Caithness, and several larger stalks of that crop standing on the field, which had grown the preceding year, with no other manure but a little burning.

Hemp seems to be well adapted to moss. The long roots of the plant are well suited to that soil, and the bulky stem and foliage would rot the moss, and render it productive next crop. Mr. Roscoe of Liverpool had some hemp sown on Chatt Moss when I surveyed it in May, 1808, and he informed me by letter since, that it seemed to be a crop well adapted to moss. The immense quantity of hemp now used in the navy, in commerce, and in manufactures, renders the growth of that crop an object of importance at all times. But when the governments of America and Europe refuse to supply us in that article, it is time for us to raise it in Britain. The mosses are proper places to raise that useful article, and we ought to cultivate it on that description of soil, and thereby render ourselves more independent of the Tyrant of Europe and his tributary States.

Flax has been raised on several mosses in Scotland. That raised by Mr. James, in the County of Dumfries, will be detailed in its proper place, and serves to shew the virtue of that crop on moss.

III. *Grasses suited to Moss.*

HOSE GRASS (*Holcus lanatus*) is the most valuable, most productive, and most easily cultivated grass hitherto in general use, on a moss-soil. It is so universally known and diffused

over all parts of Britain, that it is unnecessary to give any description of that excellent grass. Its seeds are so abundant, so easily procured, and of such hardy growth, that there can be no difficulty in extending it at pleasure. It grows on every diversity of soil, where any thing in the shape of grass can be made to spring. It grows of its own accord wherever a green sward is found.

Timothy Grass (*Phleum pratense*) has been tried on cultivated moss, and found to grow for several years in great luxuriance.

Foxtail (*Alopecurus pratensis*) and *Cattail* (*Phleum nodosum*) seem to be both well adapted to a moss-soil. Both of them bear strong resemblance to the Timothy; and I am persuaded that they would answer as well as it on a cultivated moss. I do not know, however, if either of them has ever been tried as a sown grass on any soil. They seem to have been hitherto doomed to great neglect.

Perennial Ryegrass (*Lolium perenne*) has been found to yield a valuable crop of hay upon cultivated moss. This grass is so well known, and its uses, qualities, and mode of treatment, so familiar to every farmer, that further description would be superfluous.

Common Poa, or *Rough stalked Meadow Grass* (*Poa trivialis*) grows naturally on mossy damp meadow ground, and on improved moss ground, where the soil has been limed, and has not been rendered too dry. It is a very early grass, and its seeds, which are abundant, may easily be collected, and preserved. It bears a considerable resemblance to the *Smooth stalked meadow grass* (*Poa pratensis*) which is also a plant of considerable value, and ought to be more attended to as a cultivated grass. I believe, however, it would not do so well upon moss as the other, as it delights in a dry soil; though its botanic name imports, that it is a meadow plant.

White clover (*Trifolium album*) ought to be sown on moss when it is turned into pasture. If the moss is frequently rolled, the whole clover will grow as well as on any other soil. Lime

is the manure that is most propitious to the growth of clover.

Red clover (*Trifolium pratense*) has been sown upon cultivated moss, and produced fine crops. I have seen fine clover growing on Paisley, Hartfield, and other mosses. The greatest disadvantage to which it is liable, is that of being thrown out of the ground by spring frosts. Rolling, and putting clay on the soil, are the best remedies for that evil. If the clover is not thrown out the first winter or spring, its long tap-root which goes deep into the soil, will secure it from after frosts. Moss is not the soil best adapted to the growth of clover; but it will certainly grow to advantage in that soil, especially if lime and clay are applied, and the roller duly used.

Rib grass (*Plantago lanceolata*) frequently grows naturally upon cultivated moss, and as its seeds are sold in the shops, it ought to be sown with the other grasses; especially if the moss is to be pastured with milk cows. The foliage is the only thing valuable in the plant: hence it is best suited to pasture. It has been sown on the mosses at Hartfield, to be afterwards described, and has been much approved of.

Sweet Scented Vernal (*Anthoxanthum Odoratum*) grows naturally in all mosses as soon as they begin to bear grain herbage. It and the Hose grass are always among the first of the grasses that appear. It abounds on all bent moss, even when uncultivated. The late Dr. Curtis of London, and others, have thought that the sweet odour of hay proceeded entirely from this plant. It certainly throws out a delightful smell; but it is not the only plant from which fragrant odours emanate. Some very coarse plants, as Sprits (*Juncus Articulatus*) and Rushes (*Junci Conglomerati effusi*) when bruised and hung up to dry, have a delightful smell, which continues for several months after they are cut. The *Vernal* is but a small plant, and cannot contribute much to the bulk of the hay stack; but it springs up early, has a tolerable foliage, and is much relished by cattle. It is so early as to throw off its seeds before the time that meadow hay is cut, but as they grow in the soil, they serve to thicken the sward for pasture.

Bent Grasses (*Agrostes*) are well adapted to a moss-soil, especially the *Agrostis Capillaris et Stolonifera*. They make rich pasture and excellent hay.

Fescue Grasses grow naturally in bent-moss, and in that which has been cultivated. They seem to be well calculated for such a soil; especially the sheep fescue (*Festuca ovina*) and meadow fescue (*Festuca pratensis*.)

Blue Mountain Grass (*Milica Cerulea*) grows spontaneously on moss, both before and after it has been cultivated. It is not the finest or sweetest grass, but it is eaten by cattle, and when it grows in a soil that has been cultivated and enriched, it becomes finer and sweeter. Its leaves are broad and green, and its seeds so abundant, that it can easily be procured. Its roots strike deep into the earth, and are numerous and strong, which would bind the moss soil together, and help to support the feet of cattle to pasture or to labour the moss. I am convinced that this grass deserves from the cultivator of moss, much more attention than it has hitherto received.

Couch Grass (*Triticum repens*) has justly been considered as a weed in every other soil; but in moss newly broken up, it seems to me to deserve attention. It is a plant by no means delicate of growth. Its foliage is abundant, and few grasses send up a stem so bulky. It is eaten and relished by cattle; and its long creeping roots would soon extend the plant over the surface of the loose moss, bind it together, thicken the sward, and support the feet of cattle when pasturing or labouring the moss. This plant is easily propagated, by the seeds or by the roots, and will grow from either. When a field is cleaned in the spring for potatoes, the roots might be picked up, carried to the moss, and ploughed down; they would grow and cover the moss with a close sward. It is no good objection to this plant that it is considered as a weed in other soils and situations. Every plant is a weed in ground that is cleaned for crops of grain, and every weed is only a flower out of its place. It prevails much in the Paisley moss that has been long cropped without rest; there, it is a weed no

doubt; but whenever the moss is laid down to pasture, it will not be a weed to the cow that feeds on the pasture.

There are, no doubt, some other grasses that might be propagated on moss to advantage. But those that have been named, seem to me the most proper, and they are sufficiently numerous. Till others can be discovered, let us make a proper use of them that are known to answer the purpose. If different grasses are sown, care ought to be taken to select those that are equally soon ripe. When early and late grasses are sown together, the one is withered and lost, before the other has come to perfection for hay. In pasture they do much better.

S E C T. IV.

Rotation of Crops for a Moss-soil.

WHEN bent-moss has been laid dry on the surface, limed on the sward, and delved or ploughed a year or so after, oats seem to me to be the most proper crop, for at least two, or perhaps three seasons, till the soil is properly formed. Or it may do very well to take a crop of potatoes or turnip for the second or third crop, and oats after the potatoes or turnip. The moss being thus broken and reduced to a soil by two, three, or four crops, ought to be sown down with grass-seeds, one crop of hay taken, and turned into pasture for two or three years.

When flow-moss has been dug and formed into ridges, lain exposed to the weather about two years, been again delved or ploughed, manured with lime, and if possible some dung or earth, one or at most two crops of oats may be taken, or if some dung can be obtained, the second crop may be turnip or potatoes, a crop of corn may follow them, after which grass, as above.

The great object in the first rotation is to convert the moss from peat to mould, and two or three crops will be amply sufficient for that purpose. The moss soil is not easily exhausted.

The whole stratum is vegetable matter; and if that can be made to undergo decomposition to the extent of feeding the crops as they grow, and be kept in proper order as to solidity and retention of moisture, the moss may be cropped *ad perpetuum*; or at least so long as a particle of the moss-earth remains. But when the moss is too often cropped without rest, it becomes loose and open, and by far too dry and light; it heaves, throws out the crop, and produces *witched corn*.

To prevent this, I would by all means have short rotations. The first no longer than necessary to form the soil, and all after-rotations only two crops of greens, till the moss was laid down to hay, and then to pasture. It is equally improper for moss to remain too long in pasture, as the rich grasses die away, and the aquatics begin to rise over them.

One year in hay, and two years in pasture, is the best course. I would then put on about fifty bolls of hot lime on the sward the spring or summer of the second year's pasture, plough up the moss in harvest, or early in winter, take one crop of oats, and if dung can be obtained, one of turnip, carrots, parsnips, or potatoes; next, a crop of beer, wheat or oats, and sow down with grasses. If dung for these crops cannot be found, it would be best to sow down on the first crop of oats; as the moss would probably be too soft to support the feet of horses to plough for the second crop, when the sward was gone. If it carry the horses to plough, a second crop of oats may be taken, but no more, till the moss is again rested. By the third course it will support the feet of horses to plough immediately after the crop is cut, and before the moss is soaked in moisture. That is the proper season for labouring moss at all times, so as to give it the benefit of the winter rains and frost.

When the moss is sown down with grass-seeds, the utmost pains ought to be taken to make the ground smooth on the surface. This is often neglected, and the field turned into hay and pasture, so rough, that the half of the hay is lost when mown, and the field remains uneven during the time it is in pasture. This is highly injurious to the soil. The hillocks

are too dry, formed into peat, and some of the lowest places are by far too wet.

If the moss, when first laid down to grass, does not carry the feet of cows or horses, it ought to be pastured with sheep, till it acquire solidity. The utmost care should be taken to prevent the ground being poached by the feet of cattle during the winter. I have seen much of it greatly injured by winter poaching.

I shall leave it to the judgment of the cultivator, in what manner to introduce the other species of crops that have been mentioned, as pease, beans, hemp, flax, carrots, &c. But whatever be the crop sown, or rotation preferred, the moss-soil ought neither to be long cropped without rest, nor remain long in pasture without cropping. Much ploughing and cropping renders the soil dry and loose, and when too long pastured, the moss plants return. Alternate cropping and pasture, at short intervals, is best in a moss-soil.

CHAP. V.

AN ACCOUNT OF IMPROVEMENTS MADE ON MOSS IN DIFFERENT
PARTS OF BRITAIN.

I HAVE, in the foregoing Chapters, treated of the various modes of cultivating and cropping of moss ground; but lest the directions I have given should be objected to, as mere speculation, I subjoin, in this chapter, an account, not merely of what I think might be done, but of what has actually been accomplished, in many parts of England and Scotland, which I have surveyed. When these are compared with the foregoing chapters, it will be seen, that I have stated nothing on cultivating and cropping of moss, but what has actually been achieved by one or other of those whose operations I have inspected, and detail here. If so, the public will not treat my observations as the fanciful speculations of a theorist, but as rational plans of improvement, which have been carried into effect by some, and may be accomplished by all who choose to put them in execution.

Before I published my former pamphlet, I surveyed all the moss culture I could discover, south of Perth, and framed my directions from what I saw had been put in practice. But as I did not detail the improvements which I had seen, many who read the pamphlet considered it as the plausible speculations of an enthusiast. To remove that objection, I have not only re-surveyed the improvements I had formerly seen, but extended my surveys to every corner of Britain, where I heard of moss improvement being so much as attempted, and framed my directions from what I found had been effected. To prove the soundness of these directions, and to show those that may be disposed to attempt the improvement of their mosses, where

they can find patterns worthy of their imitation, the following accounts are subjoined :

S E C T. I.

An Account of Mosses improved in different parts of England.

The cultivation of moss has not been confined to Scotland. It has been extended to England also. Our brethren there have begun to improve some of their mosses, with spirit and great success. I shall only mention a few instances of many that I have seen.

1. John Wilkinson, Esq. of Castlehead, in Lancashire, seems to have been the first in that quarter of England, who began to improve moss upon an extensive scale. The first information I had of these improvements, was in a letter from Sir John Sinclair, in March, 1805, when on his way to survey them. The honourable Baronet had the goodness to send me afterwards a copy of the account he had drawn up of these spirited improvements. I surveyed them myself in February, 1807, and again in May, 1808; and from that account, and these surveys, I am able to give the following details.

At the foot of the river Kent, an arm of the sea extends several miles inland, dividing the district of Furnes from that of Ulverston. A vast range of this frith is dry at low water, and is well known by the name of Lancashire, or Milthrop Sands. On the north of these sands, and betwixt them and the mountains of limestone, which run in that direction between Ulverston and Kendal, are some extensive tracts of flow-moss, of great depth in some places.

That which Mr. Wilkinson has begun to improve, is situated about four miles south of the foot of Windermere Lake, and twelve miles south west from Kendal. The moss is of great extent, of unknown depth in many places, and in its natural state not worth one penny per acre. Rods have been sunk into this moss fourteen yards below the surface, without finding the bottom. Many large trees, chiefly oak and fir, are

found under the moss, with the roots from which they have grown, and have been cut, extended in the natural position in the subsoil, and sometimes in the moss several feet above the subsoil.

Abundance of iron stone being found in that neighbourhood, Mr. Wilkinson erected forges, and fused iron with charred peat. The iron so made was worth three or four pounds each ton above the price of common iron; but the difficulty and expence of cutting and drying the peat, induced him to abandon the forge, and direct his attention to the cultivation of the moss soil.

He began about 1778 to improve the moss, and he has, since that period, reclaimed upwards of seven hundred acres.

The moss being extremely wet and soft, his first care was to remedy these defects by draining. Deep ditches were cut round convenient inclosures, of five or ten acres each, to drain off the water, and serve as division fences. These have been cut perpendicular on the one side, and the earth removed from the other, to let cattle drink from the bottom of the trench. About three or four feet from the brink of the precipice, thorn hedges are planted perpendicular, which have become excellent fences.

Stripes of planting are sometimes drawn between the fields, and several of these are in a very thriving state. When these are planted, a ditch is cut on both sides of the belt; the steep side towards it, and sloped towards the field, leaving the space to be planted, elevated, and completely dry. These belts are not so numerous as they ought to be, for shelter and ornament, but wherever formed, they have been executed on the most proper plan for such a soil, and the trees are thriving well. Oaks, Ashes, Firs, Elms, Birch, Limes, &c. have attained the size of trees, and are growing with luxuriance.

Besides the open drains that have been mentioned, Mr. Wilkinson has cut, at great expence, a vast number of small drains, intersecting each other at right angles, at four and a half yards distance. The conduits were covered with sod, at two

feet below the surface, and emptied themselves into the open trenches.

I have given my opinion on the utility of this mode of draining under the proper article. Mr. Tart, who has conducted Mr. Wilkinson's improvements, thinks these covered drains have been of great service in consolidating the moss; and I observe that Sir John Sinclair has become a proselyte to his opinion. Mr. Tart says, he had some of these drains opened for one halfpenny each yard in length, which is upwards of six pounds per acre. At present they could not be executed to the same extent under three times that sum.

The Honourable President of the Board of Agriculture thinks, these drains have not rendered the moss too dry, as some had argued. I have shewn elsewhere, that if under-draining was necessary in moss, it could not take effect, even when executed. The moss is so impermeable, that the water lodged in the body of the moss, would not find its way to the drain, through even a few inches. Of course, these drains would only receive what fell into them from above. From that circumstance the drains cannot be said to do very much harm; but if they are not necessary, and can do no good, as I sincerely believe, the expence which they cost is a sufficient objection. But as a thousand carts of earth, sand, or sea-mud, have been laid upon each acre, this can scarcely be now considered as a moss-soil.

These drains, besides a needless expence, have been injurious in another respect. The moss has subsided so much, that it cannot now be ploughed, without breaking up the drains; and Mr. Tart, considering them as the foundations of all his success, holds them to be sacred. The pasture has become too old, and the yellow fogs (*Hypna*) have risen high. To remove them, he harrows the sward, and applies a dressing of hot lime, which checks the growth of the fogs, and renews, for a time, the pasture.

I advised him to disregard these drains, plough the moss, and take two or three crops of oats. He did so with some fields, crop 1807, and had an ample return. He intends to

break up more of the moss for a second rotation, whatever may become of the drains. The crop on what he broke up was worth ten pounds per Lancashire acre.

Like most of his countrymen, Mr. Wilkinson has invented, what a Scotsman would consider, a profusion of machinery; as Tom-spades, Breast-ploughs, Man-ploughs, Scufflers, Pattens, Cross-cutters, &c.

After draining, a heavy frame with cutters at two feet distance is moved over the surface in the transverse direction in which the plough follows: so that by the one operation and the other, the whole surface is cut into sods convenient for being dried and burnt. After these are burnt, the ground is ploughed seven inches deep, and being harrowed, a thousand cart loads of earth, sand, or mud from the shore, is laid on each acre, and turnip planted in drills.

The land is ploughed after the turnips are taken up, and sown with oats for a second crop, which have generally been excellent. After the oats are cut, the moss is ploughed, the clods burnt, and turnips sown in drills. The fourth crop was oats. When these were cut, a dressing of compost was applied, and winter rye sown for the fifth crop. The rye has always proved a good crop at Castlehead. Grass seeds were sown on the rye; and after one cutting for hay, the moss was turned into pasture.

These were the usual courses of cropping at Castlehead. But many deviations from this rotation were made. Barley, Beans, Potatoes, Carrots, &c. have been taken into the rotation, and all of them proved excellent crops. The potato crop, in 1806, was equal to eleven hundred Lancashire, or three thousand three hundred Winchester bushels on each acre. Carrots that year, sown as a first crop, in drills, after several deep ploughings, and with no other manure than some burnt earth, yielded forty-nine pounds English per square yard. They were sold at four shillings per hundred pound weight, which was at the rate of seventy pounds per acre. Some Carrots measured three feet in length, and eleven inches round at the neck.

Paring and burning, of which the English cultivators seem

to be so fond, was the first mode of improvement attempted at Castlehead. But Mr. Wilkinson soon perceived that earth or sea sligh formed a much more certain and permanent improvement. On my second survey, I found that twenty thousand carts of earth or mud had been laid on the moss in the course of the year 1807.

No exact account seems to have been kept of the expence of improving this moss. That of carting on the earth; Sir John Sinclair calculates at two pence per cart, or eight pounds fifteen shillings per acre. I imagine part of it must have cost more. But supposing it to have cost twelve pounds per acre, it was no great sum for such an improvement so effectual and so permanent. But as the moss is surrounded with mountains of the richest limestone, and coal can be carried to it on water, I think it might have been better to have laid on about three hundred, or at most four hundred carts of earth, and applied more lime.

Low Canal Field, extending to about four acres, was manured with about eighty carts to each acre of roasted or torrifed clay; and it has ever since been the most productive meadow ground in that part of Lancashire. It has yielded from forty to forty-five large cart loads of hay every year, for the last ten years. The first cutting of hay from that field was sold in summer, 1806, at ten pounds per acre.

It would appear, that ignorant and narrow minded people have endeavoured to decry the spirited efforts that Mr. Wilkinson has made to improve his moss, and asserted that he might have purchased better land for the money he has expended on the moss.

In a matter so imperfectly understood as moss culture was in that neighbourhood at the time he commenced his operations, some errors may have been committed, which time and greater expence will correct. That of making so many covered drains is the greatest error I have been able to detect. But even the expence of these, and of laying on more earth than might have served, cannot amount to any great sum. The manure applied has been but small, the crops have been

in general luxuriant. The moss was not worth a penny per acre before he began to improve it, and it would now rent at from three to four, perhaps five pounds sterling per acre. I do not know what may have been lost by experiments or blunders; but I am confident that the soil may be formed into proper shape, the earth put on, and manure applied, for twenty pounds per acre. Some of the first crops may have misgiven, but many of them were excellent; and if the land can be made to yield even three pounds of rent afterwards, the speculations must be profitable.

The clamour of the ignorant and prejudiced ought not to be regarded, and I am confident that Mr. Wilkinson held them in derision. Sir John Sinclair, who surveyed these improvements in April, 1805, concludes his account of them in the following words, "Mr. Wilkinson must derive high satisfaction from the plan he has pursued. By so doing he has furnished employment to numbers of industrious people—he has raised a great quantity of food for man, where nothing, but for his exertions, would have been produced—he has shown a noble example to his neighbours, if they choose to follow it—and by augmenting the value of five hundred acres of barren waste from twopence to thirty shillings per acre and upward, not merely for a few casual crops, but on the principles of substantial and permanent improvement, he is justly entitled to be ranked among the best friends to the agricultural interests of this country."

To a tribute so justly due, and a compliment so handsomely paid, by one so eminently qualified to judge, it is unnecessary for me to attempt to make additions.

A friend of mine who surveyed these improvements in summer 1810, alledged to me, that the ground reclaimed at Castlehead was not pure moss, but contained a considerable admixture of sea sligh or mud. In this I am confident he is mistaken. The whole is pure moss of the light flow kind, some of it of great depth. Many thousands of tons of it were cut into peat, by Mr. Wilkinson, charred, and used in making iron, and it continues to be cut and used for fuel to thousands of families.

The whole is moss, pure moss, and nothing but moss, so far as I know or was able to discover.

Bathetgreen or *Wetherlack* Moss, about four miles east of Castlehead, is a branch of the same range of moss, extending ten miles up a glen, on the east side of a mountain of limestone, called Whitebarrow hill, or Wetherslack-scar. This moss is of bad quality, and very deep and soft. It belongs to several proprietors, and is occupied by many tenants; some of whom have begun to cultivate part of the moss: but in general these attempts are ill conducted, and the returns have been but scanty. It seemed to me as if it had been improved under moon-light, or by women only. Burning is the chief manure, though there is as much lime within a mile of the moss as would manure the Island of Britain for a thousand years. Some grain has been raised, even by their slovenly modes, but, under proper treatment, this moss might soon be made to produce a large quantity of fine grain.

Lighton Moss, situated a few miles south of Castlehead, is several hundred acres in extent, and in aspect and quality it resembles that which has been improved by Mr. Wilkinson. As it lies near his mansion, and in its full view, the proprietor has begun to improve the moss. As he was from home when I called, I did not obtain the most correct information as to the particular modes he has pursued. Deep drains have been opened to receive the water, and valves placed on the mouth of these to prevent the influx of the sea at high water. Paring and burning has been practised, some earth has been laid on the surface, and abundant returns have been obtained. The ridges seemed to be raised too much, and to be scarcely so smooth and well formed as I could have wished. Some part of the moss however, after being pared, burned, dressed with earth, and cropped for three or four years, has been set at four pounds sterling per acre for a Lease.

Several extensive ranges of moss are to be met with towards the southern parts of Lancashire; as Trafford Moss, Ellshaw Moss, Chatt Moss, Redgele Moss, Peeling Moss, Hatsal Moss, Mertonmyre Moss, &c. &c.

2. *Trafford Moss* is situated near to the house of Trafford-Hall, about four miles north-west from Manchester, on the south side of the river Erwell, and is in extent near a thousand acres. It was, when begun to be cultivated, a flow-moss of the most unsightly aspect, of the least possible value, and in some places near twenty feet in depth.

The proprietor did not choose to risk the expence of improving it, but set the greatest part of it, which was of the least value, to Thomas Wakefield, Esq. of Liverpool, for ninety-nine years, at one shilling per acre of yearly rent. William Roscoe, Esq. of Allerton, late Member of Parliament for Liverpool, having become partner with Mr. Wakefield, to the extent of one-third of the concern, they began to improve the moss with great spirit. Mr. Wakefield, having the largest share, and being more conversant than his partner in rural economy, conducted the improvements, and resided for some time at the moss.

Having often heard of these improvements, I resolved to gratify my curiosity by actual survey. Having reached Liverpool in May, 1808, Mr. Roscoe had the goodness to carry me from his house in his own carriage, to the moss, and to spend several days pointing out the improvements there, and at Chatt Moss. But as he had not himself planned or superintended the improvements of Trafford Moss, but devolved that charge on his partner, and as I did not see Mr. Wakefield, I cannot detail the particular *modi operandi*. I saw that many drains had been cut. Some of them were open trenches of great depth, to serve as main drains, and as division fences, and others covered drains similar to those at Castlehead, that have been mentioned. Part of the moss was trenched. Much of it was pared and burnt. Earth, sand, clay, marl, &c. were spread on the surface. Dung was brought from Liverpool and Manchester, and lime from various parts, by the Duke of Bridgewater's canal, which passes through the moss.

Every species of crop has been raised; wheat, bear, turnips, cabbages, carrots, &c. have all been tried, most of them have

made good returns, and sometimes the most luxuriant crops have been obtained.

I could discover that some plans of operation had been attempted, that seemed to me to border on extravagance, and did not answer expectation. In this light I viewed the under-drains, trenching, paring and burning. A portable waggon-road of cast iron, on which the manure was carted over the moss; and a plough of enormous dimensions, to be drawn by eight horses, fall under that description. I believe Mr. Roscoe always viewed them as whimsical, but allowed his partner to proceed in his own way.

In a branch of improvement so imperfectly understood, it is noway surprising that many errors should have been committed. That will happen for many years to come. But I trust neither the portable waggon-road, nor the plough of the giants, will ever be again brought on the field.

But though some money may have been expended to little purpose, and though some errors may have been committed, yet the improvement upon the whole, when separated from other circumstances, has turned out to good account.

Mr. Wakefield's share of the Trafford Moss was, before the cultivation was so complete as it has been since made, sold to Mr. Langard of Manchester, at near two thousand pounds. That Gentleman has since made great improvements, and raised the finest crops of wheat, barley, oats, pease, beans, potatoes, turnips, carrots, &c. that are to be seen growing in that part of England.

That division of the moss which fell to Mr. Roscoe, is now under lease to a tenant, who pays of rent four pounds per acre for the first seven years of his lease, and five pounds for the remaining years. From the improvements recently made by Mr. Langard, a still greater rent might be obtained for his division of the moss. Five pounds sterling per acre, however, is no inconsiderable rent, and should, in my opinion, cover all the expences that have been in any shape incurred.

I was much surprised on finding that Mr. Trafford, the proprietor, has not begun to improve any part of what he retains in

his own possession ; especially as it lies very near his residence. I trust he will have the taste and good sense to remove from the vicinity of his Hall, a nuisance so ugly and injurious, and which he could reclaim to great pecuniary advantage.

Chatt Moss, also the property of Mr. Trafford, lies about seven miles from Manchester, on the Liverpool road ; and is of much greater extent than Trafford Moss. *Chatt Moss* is of an unknown depth. I saw rods sunk fourteen feet deep on the very outskirts of the moss, in places where peat had been cut : and I was certain that within a hundred yards the moss was more than twice that depth. I am confident that some parts of *Chatt Moss* is more than forty feet deep. It produces very bad herbage. The chief plants are heather and *Sphagnum Palustre*, with some tufts of *Eriophora*, *Nardus Stricta*, *Scirpus Cespitosus*, and in some places, a few of the *Carices*. It is smoother on the surface than the generality of flow-mosses in Scotland ; but it is extremely soft.

Mr. Roscoe has taken a lease of upwards of three thousand statute acres of this moss, at one shilling per acre, for ninety-nine years, and he began about three years ago to improve it, on liberal and extensive plans. 'Till the year 1807, little had been done, except cutting drains on the surface. At first he cut these large and deep, but for some time past he has cut them not more than a foot square, and thinks they answer the same purpose as the deep drains. The year 1807 had been spent in making roads, and levelling down the inequalities occasioned by cutting peat. Some part of the moss had been pared and burnt, and a dressing of clay-marl applied. I found near a hundred acres had been reduced to proper form, part of it cropped, and the whole nearly ready for crop in May, 1808 ; and several hundreds of acres more were then in a train of preparation. The skim-plough was tearing up the surface, many men and horses were carting on manure. Bricks were making to build a Villa and Offices. Every thing was in motion. Oats, vetches, &c. were springing up.

From letters I have since had from Mr. Roscoe, it appears,

that the oats were thin in some places, but weighty in others. The dry hot weather injured the late sown turnips, but the Swedish, and those that had been early sown turned out a fair crop. He says, from the trial he had made of carrots and hemp, he was of opinion they would be found to be particularly well adapted to a moss-soil.

It would be premature to say much of Mr. Roscoe's success while he is only in the out-set of his operations on Chatt Moss. But from what I could discover of the manner he has begun, and is carrying on his improvements, and the correct ideas he has formed on the subject, I expect they are to turn out to great account. The experience he has had in cultivating Trafford Moss, and even the errors he has been led into in conducting it, have not deterred him from embarking in an adventure much more extensive. The undertaking is truly praiseworthy, and highly patriotic. That his success may be equal to the efforts he is making, will be the wish of all who know him.

If he shall (as I have no doubt) be able to bring, in the course of twenty or thirty years, this moss into the state in which Trafford Moss has been already brought, though he should be a few thousands in advance, his income, or that of his family, will, for the remaining years of the lease, be very considerable. At the termination of the lease, the Trafford Family will realize an increase to their rental, of upwards of *Twenty Thousand Pounds sterling* per annum.

Halsal Moss, situated between Preston and Liverpool, is of considerable extent. It was, when gauged by Colonel Mordaunt, found to be upwards of fifty feet in depth in some places, and so extremely soft, that instances have been known of cattle sinking in it, and never being recovered, either dead or alive. Colonel Mordaunt began the improvement of part of this moss, about the middle of the last century, by paring and burning, which brought some abundant crops. The same mode of culture continues to be followed in that moss. The moss was not worth twopence per acre, and some parts of it would now rent at six pounds per acre. Many fine crops of barley,

clover, turnip, coleseed, clover, &c. have been raised, and rye worth ten pounds per acre. Thomas Eccleston, Esq. Dr. Barton, John Pormby, Esq. Mr. Bankes, Mr. Swift, and others, still carry on the improvement of that moss.

An Account of Moss improvements in the Counties of Cumberland and Westmoreland.

3. The Bishop of Landaff has improved a small field of moss near Colgarth House, his Lordship's seat, on the Windermere Lake. This deserves notice, chiefly from the manner in which it has been reclaimed. The moss was level, wet, and deep. Ditches were cut round it, to take off the springs; one was carried through the middle of the moss to relieve it of surface water, and the inequalities on the surface were removed.

The surface being reduced to proper form, his Lordship carried a small rill from the mountains over the moss, and by it, in times of rain, washed a considerable quantity of earth, sand, or other substance which the burn could catch and transport to the moss. This, without any other manure, converted the flow-moss into a rich meadow. The Bishop, as the reward of his industry, received several crops of excellent hay, and has for some years by past converted it into pasture. I saw this field in February, 1807, and found, that during the preceding summer, five very large milk cows had been grazed the whole season, and amply fed, on four acres and three-fourths of this moss, which a few years before could not have supported three sheep. How many thousands of acres in all the Counties of Scotland might be reclaimed by the same means, if the proprietors were possessed of the patriotic industry which has actuated this worthy Prelate!

John Sutton, Esq. of Matterdale-end, near Ullswater Lake, a few miles south of Penrith, has improved about twenty acres of flow-moss to great purpose, and with considerable profit. It was moss of sixteen feet in depth, and being wet and soft, was of small value. He reduced the surface to regular form;

divided the moss into convenient fields, with an open trench round each, to relieve the surface of water; on the sides of which he has planted thorn hedges, which had risen to excellent fences.

He next pared with a breast-spade the whole surface, dried the sods, and reduced them to ashes. He then dug up the moss into narrow ridges, limed it at the rate of sixty or seventy Winchester bushels each acre, sowed the whole with oats, and had a crop of seven Quarters per acre, being fourteen times the amount of the seed. As the whole operations in labour, together with the lime and driving, did not cost him more than six pounds six shillings, the first crop would refund that expence, and the price of the seed. One part which was sown with rye, and another part with wheat, both yielded crops equal in value to that of the oats.

This field was sown down with grass seeds on the first crop, and afforded excellent pasture for several years. When it began to be covered with fogs, he applied about seventy Winchester bushels of lime, delved up the moss, putting two ridges into one, cropped it with oats, and had a crop similar to the former. He dug it over after the oats were cut, and as the ridges seemed still too narrow, he again put two into one. It was in this state I saw the field in February, 1807, and Mr. Sutton told me he intended to take a crop of turnips that year, one of oats in 1808, and sow down with grass seeds.

Another field of the same moss had been pared, burned, and limed in the same way as that above mentioned, and was sown with rye, which grew most luxuriant, but being injured by blight, did not yield grain. It was dug early in winter, and when dry on the surface in spring, was set on fire, and burned about an inch deep over the whole field. Turnips were then sown broad cast, which turned out an excellent crop. The field was again dug, and oats equal to fifteen seeds were obtained. Ryegrass and clover were sown on the oats, and yielded several heavy crops of excellent hay.

A third field was so uneven on the surface as to require a considerable expence to reduce it to proper form. It was next

pared, burned, and limed ; and being sown with wheat, it yielded thirty bushels of grain per acre. It was dug over, and cropped with oats, on which grass seeds were sown. The oats proved a luxuriant crop, as did also the grass, except where it had been injured by the lodging of the corn. After one crop of hay, the field was dug over, two ridges put into one, and a crop of oats sown, which turned out a bulky and valuable crop. It had been sown down with grasses, and when I saw the field they had a promising appearance. Mr. Sutton, in a letter he wrote to me since I parted with him, says, "None of this ground got any dung in any shape, either in compost or otherwise. Under-drains are of no use in this live moss, nor will the roots of the grain or grasses penetrate one inch further than the spade has reached. In a head-ridge which had been limed and dressed with compost of lime and earth, and much trode, the white clover rises close and thick, but short, the moss had already sunk about eighteen inches since it was first broken up. I tried potatoes, and they turned out an excellent crop, but the rooks, from the neighbouring woods and mountains, dug up and carried off nearly the whole. I have had pease, cabbages and cauliflow-ers. The pease were short in straw, but had abundance of well filled grain. The cabbages were not large, the cauliflowerers were very fine, but all were raised without dung. The clover has gone much off, though at first it comes up remarkably. It was injured by the lodging of the corn, but I intend to try it without corn. Rolling, in my opinion, is a very material operation, but I have not used it much, except on grass. I find peat moss to be a very useful compost, with a small quantity of dung and lime, and have seen it of much advantage without either, when properly turned till fit for putting on the sward, particularly on soils different from the moss."

"I have planted Birch, Spruce, Scots Fir, &c the two former do best, the Scots Fir blows aside and appears unsightly. In planting thorn hedges, I find they grow best when a dressing of earth and lime is put under their roots."

" You will observe the climate here is very particular, from
 " our great elevation, and being intermixed with the highest
 " mountains in the north of England, and the moss's great
 " retention of frost."

Mr. Sutton's moss lies near Helvellyn and Skiddaw.

At Scaleby Castle, about eight miles North East from Carlisle, an extensive tract of deep level moss has been improved to great purpose, by ——— Stevenson, Esq. the proprietor of that Estate. The only drains there, are open trenches round the fields, and furrows formed to run into these trenches. Part of the moss has been burnt, well limed, and some dung applied, and weighty crops of oats, rye, turnips, potatoes, clover and ryegrass have been obtained. Crops of rye have been reaped from Scaleby Moss equal to *sixty times* the seed sown. The greatest part of this moss is kept in pasture, which had a promising appearance when I walked over it, in February 1807. I understood it was worth from two pounds ten shillings to three pounds per acre.

This moss has been inclosed, much in the same way as that which has been mentioned at Castlehead. Belts have been formed in the same manner, with a deep ditch on each side, steep towards the belt, and sloping towards the field, and Oaks, Elms, Ashes, Firs, Beech, Birch, &c. grow well, and have attained considerable size where the moss is of unknown depth. The thorn hedges grow well on this moss.

At Wallbay, in that neighbourhood, William Richardson, Esq. had cultivated some mosses to great purpose. But that Gentleman having died before I made my tour, and not meeting with any person on the spot, who could give me correct information, I shall not venture to give details.

S E C T. II.

Mosses improved in the County of Dumfries.

THE best conducted operation of this kind I found in Dumfriesshire, was that executed by Nicol Shaw, Esq. on a corner of Locher Moss, about a mile from Dumfries, on the Annan road; where forty acres, or so, of as little value as any moss could be, and rendered unshapely by the cutting of peat, has been reclaimed, brought into form, and become highly productive. Ditches were opened for fences, and to carry off the moisture. The moss was levelled at considerable expence, and formed with proper declivity towards the open drains: thorn hedges were planted, which did not succeed at first, but were growing well when I saw the moss in 1807, and in 1808. Some stripes, or rows of trees, planted between the fields, are thriving well, and some of the Birch hedges are excellent. Lime, dung, and compost have been used as manure. Mr. Shaw disapproves of burning or trenching. He has sown oats, barley, and wheat, and had excellent crops of each; but he found the wheat sometimes injured by the heaving of the moss in spring and beginning of summer. He generally took two crops of oats on the first manuring; then potatoes or turnips, and oats, with grass seeds. His crops of clover and ryegrass have been excellent, and the pasture as good as any I saw in that county. He always finds the rushes and other moss plants begin to rise by the third or fourth year. The remedy he uses is a dressing of manure, and one or two crops of grain, after which his hay and pasture are renewed, and as good as ever. He approves of putting some earth on the moss.

As I did not find Mr. Shaw at home the first time I surveyed his improvements, and had not time to wait on him when I went over the field next year, and as he died soon after, I cannot describe every part of his operations, but I can say from ocular survey, that I have never seen a cultivated,

field of flow-moss covered with a finer verdure. It looks like some enchanted spot in the side of a dreary desert.

About 1797, Mr. John James, officer of Excise, at Wall-bay, in Cumberland, took a lease of some moss ground at Chap-leknow, on the Estate of Springkell, and began to labour and crop some part of it. He brought north a profusion of spades, rakes, hoes, and other utensils, fancifully constructed, at great expence. By paring and burning he raised excellent crops of barley, and had good clover and ryegrass after the barley. He raised on deep moss the best crop of flax that had ever been seen in that part of Dumfries-shire.

His house was burnt, and he died soon after. But James Dickson, who has now right to his lease, continues to pare and burn the moss, and by the aid of some lime and dung, has raised luxuriant crops of corn, beer, potatoes, turnip, clover, &c.

Sir William Maxwell improved a few acres of moss, about a mile East of Springkell House, as a specimen, to show his tenants what may be done. As I did not see this moss till after the death of Sir William Maxwell, nor meet with any of the people who had been employed in its cultivation, I did not obtain from Sir John Maxwell, who had been abroad with his regiment when it was improved, such correct information as to enable me to describe the mode of procedure. But I found it covered with a fine carpeting of rich grasses, and in as far as I could judge from the state in which I saw it, I believe the cultivation had been well conducted. I saw none of the *Bryum Purpurium* growing, and therefore concluded that the moss had not been burnt.

The Earl of Mansfield's Estate of Cumlungan, comprehends a part of Lochermoss: and his Lordship, wishing to reclaim some part of the extensive waste, brought an Overseer from England, to whom he devoted that charge. That Gentleman set a great number of labourers to work, to cut trenches of great dimensions, and to dig up and burn the moss. I do not know what crops were sown, or what returns were obtained; but when I walked over the moss in 1807, the *Bryum*

Purpurinum was the chief crop visible. The trenches, of enormous dimensions, seemed to me to be money thrown away, and the burning I also dislike. It would appear that the Earl had not found the moss culture turn out to his expectations, for he soon abandoned his project, and thereby confirmed the prejudices of his tenants against that mode of culture.

About forty acres of this flow-moss, which his Lordship began to cultivate, has been set to a tenant, who proceeds with greater caution, and better success, in its improvement, than his Lordship had done. Another tenant of the Earl's has begun to do a little, and I trust their better conducted operations will show the people in that quarter, that the improvement of moss, though it may be misunderstood, and money lost in whimsical speculations, is not by any means impracticable.

SECT. III.

An Account of Moss improvements in the County of Lanark.

1. Improvements of Moss in the Parish of Strathaven.

Strathaven Moss was, according to the best information I have been able to procure, the first moss in Scotland, or at any rate, in the western counties of it, from which grain was raised. The mode of cultivation by which it has been reclaimed was not borrowed from Ireland, but discovered, and reduced to practice, by the proprietors and tenants, who have reaped much wealth from it, in reward of their industry. The quantity of corn which that moss has yielded has been immense, and the melioration of the soil has far exceeded any thing to be seen in the west of Scotland.

This flow moss is situated within a quarter of a mile of Strathaven church, and extends to near two hundred acres. It is surrounded by higher lands, belonging to ten or twelve proprietors; to each of whom some part of the moss also pertains.

On the verges of the moss, and between it and the ploughable land, lay some misk or bent-land, covered with coarse benty herbage, but the centre of the flow was moss of the wettest and least valuable kind. As a great number of springs arose on all sides of this flow, and a considerable stream of water ran through, or rather over the moss, the lower parts of it were almost a loch, until a cut was opened about sixty years ago, to carry off the water. That this flow had formerly been a wood, is evident from the vast quantity of timber still found under the moss. In this, as in many others of our deep mosses, large trees are found on the subsoil under the moss, and great numbers of small trees, mostly Birch, are found several feet higher in the moss. Their roots being found adhering and extended in the natural position, proves that these trees have grown spontaneously after the moss had risen over former generations of trees. This also proves, that Birch and other aquatic trees will grow in moss soil, if they are only planted and protected.

This flow is of various depths, from one to twenty feet. From its land-locked situation, and the water that ran upon it, no flow could be softer or of less value. Till about the middle of last century, one hundred acres of it was rented at half-a-crown, and a long lease of it might then have been got at a halfpenny per acre.

About the year 1750, the late Mr. Hamilton of Collinhill, proprietor of a large tract of the moss, began to cultivate some part of it. He first ploughed some of the bent on the verge of the flow, and finding that it yielded a tolerable return, he proceeded to delve and crop part of the flow itself. He applied a little dung to what he laboured, (no other manure being then used in that neighbourhood,) and the crops it yielded were very abundant. Mr. George Cochran, surgeon, perceiving Mr. Hamilton's success, began a few years after, to labour part of the flow, on a more extensive plan. Their success roused others to industry. Most of the neighbouring proprietors began with labouring a few falls at first, and extending their operations from year to year, till the whole flow, (save a few

roods of the driest and least valuable, on which a servitude for peats is held,) has, many years ago, been improved and rendered highly productive. As far back as the year 1760, and 1764, leases were taken, and purchases made of part of the flow, for the purposes of labouring and cropping it. A large tract of it, which forms part of the Estate of Newton, has long been under leases, in small lots, to tenants, who, when industrious, have drawn considerable profits from their bargains. I have not been able to discover the rent paid by some who first began to break up the moss; but for thirty years past, the rent to the first cultivator has been ten shillings each acre per annum, for a lease of twelve or fifteen years, but the first year rent free. A turnpike road, which happened to be formed through this moss in the year 1772, and another in 1790, greatly facilitated its improvement.

Though this flow was as soft and wet as any flow ever was or could be, no draining has ever been executed upon it, save a deep ditch opened to carry through the burn that overflowed it, and such inlets or furrows as were necessary to relieve the surface of the flow from stagnant water. No draining nor under-draining was ever attempted upon this moss, beyond what would have been done, had the soil been composed with solid clay, loam or sand, instead of moss. Even where springs rise up from the subsoil, or on the verges of the flow, all that has been done was to open a small channel to the water, seldom deeper than the ordinary furrows. The ridges are formed from six to twelve yards broad, and never raised more than a few inches on the crown. The furrows are about a foot wide, and from six inches to a foot deep. No part of this flow, though it is nearly level, has ever suffered from want of draining. On the contrary, those parts of it which have been least drained, have always been the most productive. Wherever the ridges have been raised higher than their usual, or upon the sides of the roads or burns where the drains are deep, the crop has sometimes suffered from the want of moisture. But no part of it has ever been hurt by an over quantity of moisture, except where water has been allowed to stagnate. One of the proprietors,

Robert Mickle, had raised the ridges of his moss somewhat higher than usual, and it was found greatly to injure it : but his heirs perceiving the error, are now forming it into broad lands without furrows.

This moss has always been laboured with a spade, for the first twelve or fifteen years, but much of that which was first laboured, now bears to be ploughed with horses. The longer it is cultivated, it becomes the more solid, and gradually sinks lower on the surface. Some parts of this moss have sunk perceptibly in the course of a few years, and will soon be annihilated to the clay. If a road be formed through a flow, and the moss allowed to remain uncultivated, from the weight of the road, and growth of the moss on the sides of it, the road will soon appear as if sunk in the moss. But if the flow be brought under cultivation, the moss will sink so fast, that, in a few years, the road will appear as if it had been raised high by forced earth. The flow at Strathaven, and that at Flat, in the neighbouring parish of Glassford, prove these facts to a demonstration. The road formed through Strathaven flow, in 1772, is now near three feet higher than the cultivated moss on the sides of it. It begins to have the appearance of a mound of earth raised through a valley. The other road, made in 1790, has not yet risen so far above the moss on the sides of it, as the other, but it is evidently a foot or two higher already, and is fast rising. This cannot proceed from any growth or accumulation of moss on these well frequented roads. On the contrary, both of them must now be considerably lower than when they were first formed. The weight of the road-metal, and pressure of carriages, must have sunk and consolidated the moss-earth considerably ; and the deep drains on both sides these roads, must have given vent to the water which distended the moss-earth : yet such are the effects of cultivation, in consolidating the moss, and lowering its surface, as to sink it much farther. The drains and sewers were cut in both these roads several feet below the surface ; but the moss has sunk so much by culture, that those in the road made in 1772, do not now sufficiently relieve the surface of the moss from water, and must instantly

be sunk deeper. It is not merely the side drains which I here refer to, but the sewers which run across the road, and are now way filled or grown up. On the contrary, the road through the moss at Flat, which has not been cultivated, has now the appearance of a groove or canal cut in the moss. As the drains on the sides of this road are not one-third part of the depth of those on the sides of the other moss that have been described, that road cannot have sunk so much as the roads through the Strathaven flow; yet such is the growth of the moss in the one case, and the sinking of it in the other, that while the one road has risen like a mound, the other has the appearance of being sunk like a groove. *

The only manure ever applied to Strathaven moss was dung, generally at the rate of five or six tons per acre, every second or third year, thrown on with the seed. Two-thirds of this moss has always been cropped with oats, and after the first or second crops, when the soil was not duly formed, generally from eight to twelve bolls of excellent oats, have been reaped from each acre; and in many instances, more than sixteen bolls of corn, of the best quality, have been taken from one acre of this moss †. The grain it yields is better in quality, and more productive of flour, than that growing on the adjacent dry lands. Potatoes, flax, barley, some wheat, and some pease have been raised from this flow, and the crops excellent; but oats have been the most common crop.

This flow, with the modes of labouring and cropping that have been described, has, for many years past, yielded more grain, than twenty times what has been produced, on the

* Part of the moss lands of Collinhill, that were begun to be cultivated about forty years ago, marches with some of those of Newton, that were not begun to be laboured till about 1790. At that time Collinhill moss had sunk three or four feet below the other. Since the moss of Newton came under cultivation, it has sunk considerably, but it is still two feet higher than that of Collinhill, originally, in every respect, equal to, and level with it.

† The crops of oats cut from some parts of this flow, in the harvests 1799, and 1800, brought, at the common prices of these years, upwards of thirty pounds sterling per acre!

average, of the arable land in the shire of Lanark; and its rent has been doubled a thousand times! The whole flow will now rent at from two to three pounds sterling per acre.

The industry which has effected such a change, merits the highest praise. Dr. Swift remarks, that a man who makes two ears of corn to grow where only one grew formerly, is of more service to mankind, than the whole race of politicians put together. What praise must there be due to them who have raised many thousands of bolls of grain from a morass, which had never yielded one ear of corn, till reclaimed by their industry? They have done more good to mankind, than if they had founded a church, or formed a new sect of worshippers. It would, perhaps, be difficult for some of these holding very extensive property in that neighbourhood, to point out as much improvement made by their families for a century past, as has, in this instance, been achieved, by the industry of a few poor people, in the obscure town of Strathaven. Several hundreds of bolls of corn are now raised every year from a barren waste, which many persons yet alive have known rented at *two shillings and sixpence* per annum. Their example is worthy of imitation, and, I trust, will rouse others to similar acts of industry. If patriotism and philanthropy actuate the mind, what can be so gratifying as to convert the desert into a fruitful field? If wealth is sought after, where is it possible to reap a greater profit, than in raising a rent-roll from half-a-crown to *four hundred pounds* per annum, in one's lifetime.

It is true, that the value of land has greatly increased within that period, even where no improvements have been made. But the rent of a deep flow or lake, has not been, nor can be advanced, unless improvements are made. Had the rental been doubled ten times, still it would have amounted to no more than a few shillings, but their industry has raised it from two shillings and sixpence to four hundred pounds.

Part of this moss was lately set in a lease at from forty shillings to forty-eight shillings per acre. Six acres of it, the property of Mr. Tennant, merchant, is, with a house, barn, and byre, set at twenty pounds per annum. And a lot, of which

one-fourth or more is deep moss, is set on a lease at near five pounds per acre.

Every moss in Avendale, and most of those all over Scotland, if not lying in too great altitude, are as capable, and many of them more capable of cultivation, than the moss which I have described. It has been manured with dung, which its proximity to Strathaven afforded, in greater abundance than can be obtained in every situation : but dung is not the only, nor indeed the best manure for moss. Lime, marl, clay, sand, &c. are all powerful manures to moss, and all of them may be found in the Avendale muirs in great abundance, and may also be procured, for many other mosses, at no great distance. And, whenever the Strathaven spirit of industry for moss culture shall extend to these regions, the mosses there will be rendered as productive as the Strathaven flow.

Some of the proprietors of this moss now begin to consider it equal to the best of their land. Mr. Hamilton of Collinhill, limed a field of his moss that had been several years in pasture, and where the rushes and fogs began to appear, and having ploughed it with horses, sowed oats. They were the most luxuriant I ever saw grow, but the harvest being bad, they lodged and did not ripen. This was owing to over-liming. Mr. Tennant has begun to use lime as manure, and has carted on large quantities of earth and sand. He has begun to plant hedges in a proper form.

Mr. Hamilton of Stobbieside, and Mr. Young of Greenfield, have reclaimed all the bent-moss on their respective farms ; and Mr. Young is beginning to put hand to the deep flow moss on his farm. He had an acre or so derved and formed into ridges, which after having lain exposed to the weather near a year, he digged over slightly, put on each acre at the rate of four hundred and eighty carts of small earthy sand, from a pit dug about six feet deep, and having dunged it at the rate of sixty tons per acre, he cropped it with oats, spring 1808, and the season being remarkably favourable for that species of soil, he had a crop of more than six bolls of

good oats per acre. He sowed grass seeds, chiefly *Holcus*, on the first crop of oats, and has had two successive crops of hay equal to the best in that parish. The carting on the sand has cost him about nine pounds per acre, and he has given a slight dressing of lime to the grass.

Mr. Leeper and others, proprietors and tenants on the farm of Drumbowie, near Loudounhill, have limed and cropped extensive tracts of bent-moss, with some of considerable depth; and they have generally reaped crops the best that have ever been seen on any description of soil in that neighbourhood. The only manure they have used has been lime.

When I consider the thousands of bolls of good grain that have been raised on that single farm, within the last twelve years, and that for half a century before, the proprietor, who occupied the whole, had the utmost difficulty to keep himself and family in life; and when I look round that neighbourhood, and see many farms of equal extent, in such hands, and under such management, as Drumbowie then was, I cannot help expressing a wish that the pride and indolence by which these fine farms are kept under such an improper course of husbandry, were banished from that part of the country. This farm was sold to the highest offerer, about twelve years ago, at two thousand three hundred pounds, and the proprietors, after building two more farm houses, and breaking up some of the moss, to show what might be done, set the farm to different tenants, at near three hundred pounds per annum: and if it were now out of lease, it would bring a much higher rent.

Several tenants in Avendale have found it their interest to break up some of the mosses in their farms. Cornelius Wilson, in Crewburn, and John Loudoun, in Kairn, tenants to the Duke of Hamilton; and James Peat, and Thomas Morton, tenants to Mr. Knox, and Robert Morton, tenant to Mr. Muir, have all done a little, and others will, I trust, soon follow their example. Many thousands of acres of moss, every way as well adapted to cultivation as that of Drumbowie, still remain untouched. By cultivation of moss alone, the rent of that farm has been increased six-fold, and the tenants are making them-

selves rich. The same industry extended over the parish, would increase the rental in nearly the same proportion. But the proprietors are either too high or too low for entering on such improvements with any degree of spirit.

2. Improvements of Moss at Gartsheugh, by James Hill, Esq.

I surveyed these improvements different times, and from the information obtained from Mr. Hill's servants, I drew up an account of the manner in which they had been carried on, and the results. That account I sent to be revised by Mr. Hill, who had the goodness to write me the letter after inserted, which contains a correct narrative, of the manner in which he has proceeded in reclaiming that moss.

" SIR,

" I was favoured with your letter, with the manuscript, containing an account of the moss improvements on my farm, and its neighbourhood. I regret much not having had the fortune to have been at home when you visited this part of the Country, as I could have given a more minute account of the operations carried on here, than I suppose my servants have given to you : I still hope to have a visit from you, and to reap the benefit of your observations. The cultivation of moss is but in its infancy, and, I have no doubt, that the communication of the different practices in different parts of the country, will tend to make the principles of this branch of agriculture better understood, and to bring it to perfection.

" About eight years ago, my improvements were begun on Gartsheugh Moss, lying in the Barony parish of Glasgow, about six miles to the north east of the city. It consisted of near a hundred acres of moss, some of it sleechy or bog moss, black peat moss, and white fosey or flow-moss. These three varieties, and the gradual approximations of the one to the other,

of which there are many shades, comprehend all the moss soils in this country, but of which the flow is by far the most general. I have uniformly found sleetchy or bog moss to be the best, black peat the next, and white flow moss the worst in quality; and accordingly, as a field partook more or less of these varieties in the order above mentioned, it was attended with more or less expence to reclaim it, and the cultivation of it was more or less successful. The first, and, in general, the second species, uniformly made great returns under any system of cultivation, but in cultivating flow-moss, I have been often disappointed; at the same time, few flow-mosses have ever fallen within my observation so situated as to be incapable of being reclaimed to considerable advantage.

“At the commencement of the operations on this moss, the practice at Swinridgemuir, (which need not be detailed, an anonymous account of it having sometime ago been published at Dunse), was strictly adhered to, but the expence of the labour greatly exceeded the statement in that publication—the qualities of manure prescribed did not produce the crops I was led to expect, and even with increased quantities of manure the crops were defective. I speak particularly with regard to flow-moss, to which chiefly the following observations are to be confined. It is a pity that so economical an application of manure should have been recommended: where little manure is applied, little return can be expected, and the labour is the same whether the land be starved or enriched.

“Potatoes in the lazy-bed way, I uniformly found to be a defective crop on flow-moss, they yielded seldom more than fifteen Lanarkshire bolls ‡ to the acre: it will be observed, that of a field in lazy beds, little more than the half of the ground produces, the furrows occupy nearly the other half. The delfs or spadings of flow-moss, with drought become dry and keesened, into which the young roots penetrate with difficulty, and cannot swell to the ordinary size. After flow-moss has been decomposed, and its pores filled up, a potato crop may succeed,

‡ A Lanarkshire Boll contains sixteen pecks, each peck forty-two pounds.

but the potato crop, on all varieties of moss, is subject to be affected by the late frosts in spring, and the early frosts in harvest, more readily than on dry ground. A crop of potatoes on moss, is often cut down by frost in June, when the adjoining crop on dry ground is unaffected; for this reason, turnip is a preferable crop to potatoes, as a green crop on moss, particularly on flow-moss, in its original uncultivated state. Turnip is sown so late as to be unaffected by the late and early frosts in summer and harvest, and the root at any stage of its growth, is not so injured by frost as potatoes. The lazy beds, next year, left on the ridges perceptible heights and hollows, and notwithstanding the greatest care, a considerable quantity of the manure was lost in the furrows betwixt the beds.

“In following the practice at Swinridgemuir, I had occasion to find, that lime alone, was a very inefficient manure for reclaiming the different species of moss in this district of the country; the first crop of oats was not worth reaping, although the operations of digging, hoeing and rolling were performed with great nicety. The second crop was little better than the first. The expences of seed and labour had now so far got the head of the value of the oat crops, that I was satisfied the pursuit for profit this way was in vain, and therefore gave it up, and this makes me doubt what is written in the book published at Dunse, respecting the cultivation of moss at Swinridgemuir, by means of lime alone. Lord Meadowbank mentions, that the moss composts in which lime alone was mixed had no effect as a manure—it certainly does not operate on moss so effectually as to render it an eligible manure to apply with the first crop.

“The field this ineffectual experiment was made upon, was chiefly composed of sleetchy and black peat moss. I never now apply lime but with the crop with which pasture grass seeds are sown. A considerable capital is thus kept in hand, the lime too, by being kept on the surface has greater effect than when it is turned down, by digging to the bottom of the furrow—in gradually penetrating downwards of its own accord, the whole soil partakes of its benefits.

"The crops sensibly diminished after the second crop without the aid of additional manures, and three or four productive crops (seven or eight crops are spoke of at Swinridgemuir, with manuring only once) are certainly not to be expected.

"Having laid down the moss with the second crop of oats to grass after one crop of hay, I found the flow-moss had not acquired sufficient solidity to bear the tread of cattle; had there been taken one or two more crops of oats, with the accumulation of quick grass and other trash, which began to appear, a strong sward might have been acquired; but the deficiency of the oat crops would have been a dear price for that coarse pasture.

"The operations in the manner of the practice at Swinridgemuir on this moss, were not partial, or confined to a few acres; for all the moss, near a hundred acres, on the farm was reclaimed in that manner, but after this had been accomplished, the fields were not in the situation I expected with regard to pasture, and I was much deceived in the promised returns.

"The great defect of the flow-moss appeared to be, want of solidity, spunginess, liability to be parched in dry weather, and a total want of the component parts of earth, clay and sand. I had observed very luxuriant crops on moss-band with a little dung. Moss-band is a mixture of moss and earth. I resolved therefore to give the moss a good dressing of earth, to fill up its pores, give it solidity and alter its texture. After digging the moss in eighteen feet ridges, rather deeper than is done at Swinridgemuir, by turn spading it, and taking out a shoveling from the trench to contribute towards making a mould on the surface, forming the ridge pretty flat, with a view to retain the moisture, and making the furrows about twelve inches broad, and as many deep, a coat of earth about an inch thick was wheeled on it. A square yard will cover thirty-six yards an inch thick. At a sixpence per square yard therefore, an acre may be covered an inch thick with earth for four pounds. Furnishing barrows and planks, this dressing was done at an average at six pounds per acre. These operations were got over be-

fore winter; the frost meliorates the earth, makes it friable, and renders it a proper bed for seed. Early in spring, from twenty to thirty tons of short well made dung was applied to each acre, and was hoed or harrowed in with the seed, with a bush harrow, and then the moss was rolled. Lime was applied to the second crop, which was hoed and rolled. Grass seeds were then sowed and harrowed in with a bush harrow, and rolled. Rolling is an operation which should never be omitted; it gives the land solidity, and by smoothing the surface, makes it retentive of moisture. Two crops before laying down, after covering the surface with earth, are preferable to laying down with the first crop, and turnips should be the first crop, so that by hoeing and exposure to the air, the earth may be meliorated, for in general the quality of the earth on the sides of the moss is poor and unfertile; besides, it is of some consequence to get the moss and earth incorporated together on the surface. After scarifying the hard land to dress the moss, I apply a coating of the moss to the hard land, thus making the one a dunghill for the other.

“The first crop of oats, in general, turned out from six to eight bolls on flow-moss, and from eight to ten or twelve on sleechy or bog-moss. The second crop not inferior to the first, and the hay from a hundred to two hundred stones per acre. The moss was first sowed down with soft grass or Yorkshire fog, from a mistaken idea that ryegrass and clover would not grow. The hay crop was inferior to a ryegrass crop, and the pasture not good. Ryegrass, ribgrass, and white, yellow, and red clover are now sown here in the usual quantities, and with the same success as on dry land. The earth which is put on the moss, promotes the growth of clover, and makes it keep the ground.

“As the moss is now able to bear the plough, except a little space on the sides of the furrows, my workmen prefer thirty-six feet ridges to eighteen, there being fewer furrows, and consequently less digging, and the horses have more room to turn in the plough, and in carts. I am now throwing two ridges into one.

"Potatoes on flow-moss seldom succeeded to my wish, until it had undergone cultivation, but excellent crops of this root have been got after the matted fibres, and the roots of ling in the moss were decomposed. Kelp, or soaper's waste, raised as good and weighty a crop of potatoes as Glasgow dung.

"I am just now dressing up a field with earth on one half of which turnips are sown, the other half is intended for drilled wheat.

"The expence of preparing moss for a crop of oats as now practised here, may be stated thus :—

To dig and form the ridges, may cost per acre,	£	4	0	0
Covering it with earth, about		6	0	0
Twenty tons of Glasgow dung, carted about six miles		12	0	0
Wheeling it on, hoeing the seed, and rolling . . .		2	0	0
	£	24	0	0

The produce from six to twelve bolls according to the quality of the moss. The lime here costs about one pound four shillings per chalder, before it is got on the land, and about a hundred and twenty bolls, each boll containing four Winchester bushels, is given to the acre.

"A field of grass on the flow-moss, consisting of about thirty acres, I have let at two pounds per acre, for sheep pasture, but I do not think it will stand that rent. Instead of cutting hay from it, it was pastured the first year with sheep. Some English ewes paid remarkably well. Ten shillings of profit on their carcase—Eight shillings for their fleece—Thirty shillings for two lambs from each ewe. An acre was fit to graze three ewes, the profit, therefore, was immense. Some of them were kept through the winter, but they did no good; indeed I had been previously warned that they would not do, unless they were on dry land. A few of the lambs of the English ewes, which were kept through this winter, however, stand it as well as the blackfaced breed; they begin to be habituated to the soil.

"After the moss has undergone one earthing, dunging, and liming, and yielded a crop of turnips, oats, and hay, the sleet moss or bog ground should afford in pasture a rent of from two to three guineas. Black peat from one guinea and a half to two guineas per acre, and the flow from twenty to thirty shillings. Any person may calculate the expence of the different operations and manures, and the probable produce of the crops. They will vary in different situations, but it will be rarely found where the hard land on the same level brings oats to maturity, that flow-moss of the worst description cannot be improved to advantage.

"Burning was tried on part of a field of this moss. Whether it was owing to the operation being unskilfully performed, or that the ashes were very poor, that the crops were defective, I cannot pretend to say; possibly both of these causes may have contributed to the failure of the crop—the attempt has not been renewed. It is certain, that the ashes of flow-moss are not so rich in quality as the ashes of black peat or bog moss, and where the moss is burnt in this neighbourhood, the texture of the soil becomes loose and deafish; it wants *bane*, as the farmers here name it, and sorrel appears afterwards in considerable quantities.

"I derived considerable benefit in my operations from making use of pattens on my horses, invented by Dr. Jeffray, by which a horse may do all the operations on moss which can be done on dry land. A considerable sum is thus saved in harrowing and rolling the moss, and carrying off the crop, for which purpose I use a sledge. After the moss has acquired a little solidity, I have used these pattens in ploughing.

"I observe what you have said respecting the improvements carried on by Mr. William Menzies, at Gartloch. Too much indeed cannot be said in his praise. It is from the successful practice of such men that the cultivation of moss is to become general; and I am happy to say, he has been by far the most

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successful cultivator in this district: that he will be amply repaid, there cannot be a doubt."

"I remain,

"SIR,

"Your most obedient humble servant,

"JAMES HILL."

"GARTSHEUGH, 7th July, 1807."

"Mr. WILLIAM AITON, }
WRITER, STRATHAVEN." }

John Harvie of Garthamloch, Esq. improved, on his farm of Gartloch, about thirty acres of flow-moss, of the worst description, and increased its value from less than sixpence, to thirty shillings per acre of yearly rent. I understand he followed the Swinridgemuir plan, but he is of opinion that some earth ought to be laid on the moss. The moss which he has improved had a fine rich sward of good grass when I saw it in 1805, and 1807.

William Menzies, now tenant in that farm, has on a lease of nineteen years only, and without being bound in his tack to do so, improved sixteen acres, mostly flow-moss, of the worst quality. The moss which he has improved, seems to have been once a lake, and to have grown up by the successive crops of lake plants; and those that sprung up on the surface after the turf had risen above the water, were the Sphagnum, Eriophora, and worst of the moss plants. I found Mr. Menzies and his servants covering the seed for a second crop, by hoeing, and the flow was so soft, that I sank above the ankle. The soil had no appearance of earth. The organic texture of the Sphagnum remained little impaired. Yet with a small quantity of dung, he reaped five or six bolls of oats for the first, and generally ten bolls for the second crop. The only drains he has cut are furrows, about a foot deep between the ridges, twelve yards wide and nearly level; and these furrows emptying into an open ditch, which separates his moss from that of Mr.

Hill. After two, or sometimes three crops of oats, with a moderate quantity of dung, he sows grass-seeds, takes one crop of hay, and turns the moss into pasture. Such an instance of industry in a tenant, on a short lease, and voluntarily, is highly meritorious, and may serve as a reproof to proprietors, who neglect the improvement of their mosses that are much more inviting.

The improvements made on deep flow-moss by Dr. Jeffray, and by John M'Kenzie, Esq. of Garnkirk, are highly interesting, but as they have generally proceeded in the manner that Mr. Hill has done, and their success has been similar to his, any detailed account of them would be to little purpose. The fact is, that though I have walked over these improvements different times, I delayed taking the proper information, until I should return at some future time, and which other avocations, has prevented me from getting accomplished. In general, I can say, their improvements are of considerable extent, and well conducted.

SECT. IV.

An Account of Moss improvements in the Shire of Ayr.

THE industrious and intelligent inhabitants of this populous County, have, to their improvements, added that of moss culture, to a much greater extent than is to be met with in any other County of Great Britain. They were among the first in Scotland who began to improve moss. Alexander, Earl of Eglinton, and others, raised by burning and manuring, some fine crops from Shewalton Moss, before the middle of last century. Mr. M'Culloch raised good crops of corn on part of Galston Muir, as early as 1760, and some of the tenants on the Estate of Loudoun, limed bent-moss on the sward, and raised good crops soon after that period. James Brown, in

Muirend of Fenwick, James Roxburgh, in Rushaw, and others, began about the same period to improve their mosses.

1. Improvements at Swinridgemuir described.

John Smith, Esq. of Swinridgemuir, has the merit of being the first in that county, or perhaps in Scotland, who attended to the improvement of moss on scientific principles. He began about 1785 to reclaim some of the mosses on his Estate, manure them with lime, and to raise excellent crops of oats, and his tenants and neighbours soon followed his example. His success and that of his tenants, who acted by his directions, soon attracted general notice, and so many people went from all parts of the country, to see his improvements, and to be instructed in that branch of industry, that he found it necessary, in 1797, to publish an account of his improvements. As that pamphlet has undergone several editions, I shall only give a short and general account of these improvements, referring to the pamphlet itself for farther particulars.

The first thing to be done, he observes, is to open master drains to carry off the superfluous water, and serve as fences. The ridges, he says, should be six or seven yards broad, and where the surface is tolerably smooth, the ridges ought to be dived up towards the middle in the way a ridge is ploughed, only the last furrow should be cut deeper, and thrown in detached pieces over the rest.

The following remarks are so judicious, that I copy them with pleasure, and recommend to all who improve moss to attend to them. He says, "It may be observed that the success of the after crops depend upon a proper formation of the ridges. They must not be made too high in the middle, for there they will be too dry, like a peat upon which the lime cannot act, and near the furrows they will be too wet, which is equally prejudicial. They should therefore be constructed with a gentle declivity to the furrows, so as the rain

“ which falls, may rather filtrate through the ridge to the furrows than run quickly off the surface.”

After having made repeated trials of different kinds of manure, he gives the preference to lime, or other calcareous earth. Dung without lime he thinks incapable of reclaiming moss, and when it is applied with lime, otherwise than for a potato crop, it does not answer near so well as pure lime. I concur with Mr. Smith, as to the powers of lime as manure to moss, but I think he under-rates the value of dung, as I have shewn under the proper head.

Mr. Smith thinks the lime should be applied in a powdery state, immediately after the moss has been delved, at the rate of four, or between that and eight Chalders per acre; five Winchester bushels being the Airshire boll, and eight bolls the Chalder of shell lime, which yields double flour. This quantity is certainly abundant, and the mode of application is well adapted to flow-moss. But wherever the moss is covered with a sward of any kind of grasses, as in the case of bent-moss, and tolerably smooth, liming on the sward a season before the moss is broken up, seems to me to be a better plan of applying manure.

As that crop often fails, Mr. Smith recommends potatoes as a first crop. I believe he is correct in that opinion; but I dislike the lazy-beds which he proposes. If potatoes are planted for a first crop, I would have the ground delved a year before, and plant the potatoes in drills. This forms a soil of sufficient depth, and the repeated delving, hoeing, &c. breaks and pulverizes the soil.

Mr. Smith's mosses are generally of considerable depth, or what are called flow-mosses, and some of them too soft, he says, to have supported the foot of a dog; yet by liming, draining, and labouring, they can be ploughed with horses the third year. Five or six successive crops of oats have generally been taken. When potatoes had been the first crop, oats the second and third years have been generally equal to ten bolls per acre, and the four after crops from six to ten bolls on each acre. By the sixth crop, the sweet grasses rise too bulky for

the oats, and the moss is turned into hay and afterwards into pasture, both of which have been found equal to the best of the dry land in the neighbourhood.

It is justly remarked by Mr. Smith, that though agriculture has not attained great perfection in that quarter of Airshire, yet the tenants are so sensible of the advantages to be derived from cultivating moss, that they set about it of their own accord, even within six years of the termination of their leases. That eagerness to break up moss so near the end of a lease, shows that it has been found to be a profitable concern. The profits it yields show that the cultivation has been well understood in that neighbourhood; and as Mr. Smith was the first to introduce that useful branch of improvement into that district, his country is much indebted to him for the discovery, and the pains he has taken to give it publicity.

2. Improvements of Moss on the Estate of Grougar.

Several hundreds of acres of good soil in the higher parts of the beautiful Estate of Grougar, in the parish of Kilmarnock, are buried under moss. Part of that moss being covered with a green sward, may be termed bent-moss, but much of it is flow-moss of great depth. As lime abounds in that end of the Estate, the late Mr. William Brown, Writer in Kilmarnock, then Factor on the Estate of Grougar, suggested the idea of liming and cropping the moss; and the land-grieve having been sent to Swinridgemuir to get instructions as to the mode of cultivation, the improvement was commenced on the plan Mr. Smith had suggested.

The improvements were begun on a piece of deep flow, near Berry Hill, but as the first crops were scanty, this field was abandoned before the result could be ascertained. In 1795, a field of bent-moss, of considerable depth in some parts, was limed on the sward, delved in summer 1796, and after being exposed to the weather for a season, was cropped with oats in spring 1797. But the natural grass invigorated by the lime,

rose so high as greatly to injure the crop. The same field and another near it, both on the farm of Rushaw, were cropped with oats, at the expence of the proprietor, in 1798, but the crop on both fields misgave. After they had been dug over and were ready for the seed, they were let, for crops 1799 and 1800, to John Howie, James Howie, and Robert Shields, at three pounds ten shillings per acre. These fields yielded excellent crops both years. That of 1800 was sown without being delfed, and the seed covered by the harrow and hoe; yet the crop sold, by public roup, the lowest at six, and some of it as high as thirteen pounds sterling per acre. The hay cut from these fields in summer 1801, sold at from six to seven pounds per acre. They have been in pasture since that time, and are now much overgrown with rushes.

A field of twelve acres near Rushaw farm-house being limed and delfed, was sown with oats in 1798, and yielded a substantial crop. An attempt was made to sell this crop, but such was then the prejudice in that part of the country against moss culture, that nothing like a fair price could be obtained for the corn, and the proprietor was compelled to manufacture it for his own behoof. This field yielded in 1799, at least ten bolls per acre on an average, and some acres much more; yet owing to the prejudices of the country people, the whole sold at from six to seven pounds per acre.

The moss was then set to a tenant, who raised, crop 1800, with only twelve carts of dung to each acre, the best potatoes that ever grew in that neighbourhood. Oats next year were excellent, and grass seeds being sown, chiefly the *Molcus Lanatus*, the crop of hay summer 1802, was the best ever seen in that part of Airshire. Upwards of twenty-five bolls of seed was taken from each acre, which brought six shillings per boll.

That field remained in pasture from that time till 1806, when a good dressing of lime and compost having been laid on the sward the preceding summer, the field was ploughed with horses, and sown with oats. I saw them in the month of August, when they had the best appearance of any crop I had

seen that season. Mr. Howie informed me afterwards, that the crop was much injured by the uncommon harvest rains, but that he saved more than twelve bolls from each acre of that field. It was again cropped with oats in 1807, and when I saw it in June that year, the corn had a very promising appearance, and turned out a luxuriant crop.

Messrs. Howies and Shields took a lease of forty acres of moss, on the farm of Blackshill, nearly the highest land in that part of Airshire, for the term of fifteen years. They paid no rent for the first three years, and for the remaining twelve years they pay sixteen shillings and sixpence per acre. Having limed the moss, partly on the sward and partly after being delved, they cropped it with oats: the first crop was scanty. Some part of it which admitted of being ploughed, produced a better crop the first year than where the moss had been delved. It was equally good as the delved moss the second year, but the after crops on the ploughed moss were far inferior to those on moss that had been delved. The better crop at first was no doubt owing to the lime having lain some time on the sward before being ploughed, but in the after crops the soil was too thin for being productive. The second and third crops were sold by auction, and brought from three pounds ten shillings to seven pounds ten shillings per acre. The field was laid into grass after the third, and part of it after the fourth crop, and yielded about an hundred and fifty stones good hay per acre.

Upwards of an hundred and twenty acres of this moss had been reclaimed when I made my last survey, in summer 1807, and the value of the whole raised from one shilling and sixpence or so, to upwards of thirty shillings per acre.

No other manure has been used in general but lime, at the rate of an hundred bolls per acre. The first crop has frequently been a scanty one, but the second, except in one instance, and all the after crops have been abundant, some of them luxuriant. And as four crops have generally been taken before the moss was laid down in grass, and the hay crops always good, sometimes uncommonly heavy, the profit to one or

other must have been considerable. The proprietor must ultimately be a great profiter. He had only one shilling and sixpence per acre of rent; and in the lot last described which was of all others the least profitable, by sacrificing that rent for three years, he has sixteen shillings and sixpence for twelve years more, and his moss restored to him worth at least thirty shillings per acre; all without advancing a penny.

It was a fortunate circumstance for the proprietor, and for that part of Airshire, that the cultivation of that moss was taken up by the Howies and Shields, at a time when it was about to be abandoned by Mr. Blane the proprietor. Neither he nor his Factor were acquainted with that species of improvement, and the overseer they had brought from England, was no better informed on the subject; and from the errors he committed, and the sterility of the piece of flow-moss on which the experiment was begun, Mr. Blane had resolved to give up the undertaking. But these active industrious farmers, who had had some experience in that species of cultivation, took up the sinking improvement, and conducted it with such spirit and propriety as to remove all prejudice, and open the eyes of the proprietors and possessors of that description of soil to their real interest.

3. Improvements on Moss at Glassnock.

The exertions made by Alexander Allason, Esq. of Glassnock, to improve the mosses on his Estate, merit attention. When he bought that Estate, about twenty years past, nearly one half of its surface was covered with moss. The whole had at some former period been covered with wood, the overthrow of which had led to the formation of moss on the high and neglected parts of the Estate. Patches of bent-moss reached near the House of Glassnock; as you advanced higher the moss increased in depth, and covered nearly all the surface.

In many parts the moss was from ten to fifteen feet deep over the felled trees, mostly firs.

Mr. Allason, like a prudent improver, began his moss culture on the detached pieces that lay mixed with arable land, and gradually proceeded towards that which lay farther up. Several years ago he set a lease for nineteen years, of all the upper parts of the Estate, and nearly all his moss ground, then unimproved, to the extent of several hundred acres, for the yearly rent of twelve pounds sterling. But the tenant conceiving himself unable to pay *so high a rent*, gave up his lease in a few years after. Mr. Allason having by this time acquired some notion of moss culture, resolved to pursue his conquests to the utmost boundaries of his property, and he has made very considerable advances in that conquest.

The bent-moss he limed on the sward, and ploughed about a year after for oats, sowing down with grass seeds after two or three crops. He had not proceeded far in that mode of culture, till he was enabled to set a farm at the yearly rent of Sixty Pounds. In two or three years more, he set another farm at the rent of Fifty Pounds; and if these two farms were now out of lease, they would set at near double their present rent. But as the tenants have made considerable improvements, they have a good right to reap the fruits of their labour. Besides these two farms, he has set as much more as brings Twenty Pounds of rent, all from the farm that the tenant might have possessed for several years yet to come, at twelve pounds of yearly rent. Beside all these, he still occupies about three hundred acres of the same possession, deeply covered with moss, over which he is gradually extending his improvements.

In the years 1805 and 1806 he limed, delved and cropped about sixty or seventy acres of the higher range of deep moss, and after taking two, and in some cases three crops, he has sown down the field with grass seeds, and took a crop of hay in 1808. The crops of corn were scanty the first year, but much better the second and third years; in some places they were excellent. The hay was upon the whole above a medium

crop, from one hundred to an hundred and fifty stones per acre. He is every year extending his conquests on the moss. He will soon be able to set another farm of eighty or an hundred acres, at as many pounds of rent; the houses are partly built. In this way he will lay field to field, and add farm to farm, till he reach the utmost boundaries of his property; enhancing the value of his own Estate without diminishing that of any other proprietor's. Happy would it be for themselves, and for the commonwealth of which they are members, if all the proprietors of land in the County of Air, would follow the example Mr. Allason has set before them.

4. Improvements on Riccarton Moss.

William Parker, Esq. of Assloss, has improved on a plan liberal and well conducted, a considerable tract of the moss of Riccarton, about three miles south of Kilmarnock. This flow is of great extent, of an unknown depth, and of the smallest value. The greatest part of it is the property of the Craigengillan Family; but about forty acres at one corner belongs to Mr. Parker, and he has improved it with great spirit.

Having cut a few open trenches to relieve the moss of water on its surface, Mr. Parker, without any other draining, began about 1794, to labour and crop the flow. He formed his ridges about forty feet broad and nearly level, the furrows about a foot wide and a foot deep. He says he found no want of further draining, but was sensible that his moss was sometimes injured by being too dry.

The only manure that he applied was lime, at the rate of an hundred bolls per acre, spread in a powdery state after the moss was derved. And without further manure he has always taken four, often six, and sometimes eight successive crops of oats. The first crop seldom yielded more than the seed sown; the second was generally a middling crop, and the third and after

crops always good. He frequently reaped eight or nine bolls of good oats from each acre. A few potatoes have been planted with a small quantity of dung, and have turned out a good crop.

After seven or eight crops of oats Mr. Parker turned the moss into grass, took two crops of hay, and then pasture. The hay he considered worth three pounds per acre, but always found the second crop better than the first.

In some cases, after six or seven crops of oats on one liming he has applied about thirty single horse carts of dung to each acre, or sixty bolls of lime per acre, and then taken four or five more crops of oats. A small part of the moss was covered with a dressing of earth, not more than the bulk of an hundred bolls of lime, and its effects were obvious, but it was only a small patch that was manured in that manner.

The first delving and formation of the ridges cost three pounds per acre, and the second and after delvings cost thirty shillings per acre. That part of the flow that has been cultivated has sunk four feet on the surface.

I understand no exact account has been kept of the expences and profits of this improvement, distinct from other concerns, but Mr. Parker must have been a gainer by the speculation independent of the improved condition of his moss. This piece of flow was not worth five shillings per annum till he broke it up, and at present it would set at forty shillings per acre, or eighty pounds per annum. Suppose Mr. Parker had been a thousand pounds out of pocket, he would have had a return double what he could have expected for the same sum laid out in purchasing land. His industry has added forty acres to his own Estate, and in fact to the productive soil of Great Britain; and he has been the first to set an example worthy of the imitation of his neighbours. I wish it had been followed by the late proprietor of the other parts of that extensive flow.

I understand that Mr. Parker's operations were the subject of laughter for several years after they were begun. But these prejudices begin to wear off.

William Wallace, tenant to Mr. M^cAdam, in the farm of Moss-back has improved about twenty acres of that flow to the best purpose ; and as he has done so voluntarily, on a short lease, without any aid from the proprietor, and in spite of the prejudices that then prevailed in that part of the country, against that description of improvement, Mr. Wallace deserves much praise for his industry, and the example he has given to other tenants.

Having mislaid the notes I took on the spot, I cannot detail Mr. Wallace's modes of labouring and cropping. They were nearly the same as those pursued by Mr. Parker, and his returns both in corn and grass have been greater than those obtained by that Gentleman. This might proceed from the cultivation being conducted by himself, while Mr. Parker's was trusted to servants, or executed by contract at a distance from his residence. Mr. Wallace too has used more dung than his neighbour improver, which is the most proper manure on a flow-moss the first course of cropping.

Such industry by a tenant recommends him to the notice of proprietors who have moss on their Estates. There are some as good thorn hedges now growing on Riccarton moss as ever I saw any where, even where the moss is six feet deep.

5. *Improvements on Shewalton Moss.*

This moss covers about a thousand acres of fine level ground, about one mile south of the town of Irvine. It is a flow-moss into which rods were sunk thirty-three feet without reaching the bottom. A large tract of this flow is the property of Lord Montgomerie, but the greatest part of it belongs to Colonel Boyle of Shewalton. Some parts on the verges is bent-moss, but the greatest part is deep flow-moss of small value. Many fine trees and roots are found under this flow.

Cultivation was begun on this moss about the middle of last century, and some part of it has been broken up occasionally

since that period. John Dunlop, Esq. Factor to Lord Montgomerie, David Blair and others his Lordship's tenants are still making some encroachments on the flow. Some part of that which belongs to Colonel Boyle has been drained by open ditches, and partly reclaimed. I found the cultivators of this moss rather more disposed to burning than I could wish. The drains are also cut deeper than necessary. Lime has been the chief manure. Some excellent crops have been obtained, and part of the flow is now worth from twenty to forty shillings per acre.

The liberal and well conducted improvements carried on by Mr. Dunlop, on the farm of Auchans, merit attention, and serve as an excellent example to the tenants on the Estate. I wish every Nobleman would employ such factors, and set such examples before their tenants.

6. Improvements of Moss at Mountgreenan.

Robert Glasgow, Esq. of Mountgreenan has begun to cultivate some of the mosses on that Estate, with spirit and propriety.

Some of the bent-moss on the verges of the flow, he has limed, laboured, and cropped in the ordinary way, and after reaping several crops of fine oats has turned the ground into hay and pasture, both equal to the best land on his Estate. He has also planted belts of trees and thorn hedges on some of these mosses, which are thriving well.

But Mr. Glasgow has not confined his operations to the outskirts of his mosses, he meditates the restoration to fertility of the whole of those on his Estate; and he has begun to put his designs in execution on some of the deepest and most forbidding.

After cutting drains round convenient fields of the moss, which also serve as fences, and forming roads where necessary, he delves the moss, forms the ridges, lays on two hundred bolls of lime on each acre, and leaves the field exposed to the

weather for twelve or eighteen months ; he digs it over a second time, and sows oats. Sometimes he only hoes instead of delving the second time, which I consider better than delving.

Mr. Glasgow's operations on the deep mosses only commenced about five years ago. I saw his first crop when in the blade ; it looked well, but turned out a poor crop. I saw the second crop in the same stage ; it looked better, and turned out a tolerable crop. He had, when I was last on the field in June 1809, more than twenty acres in crop, and as much delved, limed, and in a train of preparation ; all deep flow moss of the worst quality.

Mr. Glasgow's improvements on the flow-moss had not then proceeded the length to enable me to say what may be his ultimate success ; but in so far as I am qualified to judge, his operations are well conducted, and his improvements begun and carried on with great spirit.

7. *Improvements on Hillhouse Moss.*

The Reverend Mr. Laurie, minister of Loudoun, is proprietor of the lands of Hillhouse, in the parish of Riccarton, in which about twenty-two acres of lake moss of the worst quality is situated. It had lately been a lake which served as a reservoir to supply a corn mill, and a meadow in summer.

Bruce Campbell, Esq. the late proprietor, cut about twenty years ago, deep drains through this lake in all directions, and having burnt part of the turf, he reaped some good crops. Mr. Laurie's tenant put some effete lime on a part of this flow in 1805, and having delved it up into ridges twelve feet wide, and raised them high, he cropped it with oats, but had a scanty return.

I surveyed this flow in Spring 1806, and finding it was composed of lake-turf, formed in water, which had been drained off before the lake had been completely grown up and the moss formed over it, and that the former burning, over-drain-

ing, and raising the ridges too high had rendered the soil open, light and dry, I advised the proprietor to take it out of the tenant's hand, form the ridges broader and not so much raised, and to cover the whole with a dressing of earth, clay or sand.

Mr. Laurie followed my counsel. That part of the flow which the tenant had cropped (eight acres) was dug over in Spring 1806, two ridges put into one, and less raised in the middle, a considerable quantity of earth was laid over the surface, and oats with grass seeds were sown.

But as the operations only commenced the 4th of April, and the seeds were not sown till about the 9th of May, the weather dry, the earth steril, and no manure applied, the crop was not heavy. The hay next year was a light crop, and in 1808 scarce a medium crop. The nature of the herbage, however, is completely changed, the sward is close, and the grasses sweet and good.

The rest of the flow, which had never been broken up, was dug into proper form next Spring, some of the drains filled up, and a dressing of clay and sand laid over the whole, more than two inches thick. But the moss being of the worst kind, mere turf composed of the remains of the *Nymphaea*, *Arundo*, *Scirpus Lacustris*, *Equiseta*, some of the worst of the *Carices*, &c. not formed into moss, but remaining a loose fibrous turf; as the turf was newly dug up, and not reduced by the weather to mould; as the earth and sand laid over it was taken six feet under the surface and very steril, and no manure applied, the crop could not be a good one. The clover had taken root in abundance, but the grass had failed, owing probably to the seeds being bad, of course the sward was but ill formed. But though the crops have not been good, the earth laid over the moss ensures ultimate fertility. The sward will grow better every year, and the growth of the aquatics has been put a stop to by the earth. Lime, however, or some manure, ought to be applied, especially to that recently broken up. The moss in it was of the worst kind. The earth steril, and no manure has been given to either. It would be proper to give a good dress-

ing of lime, dig up the soil to mix the moss and earth, and thereby reduce the moss more completely.

SECT. V.

MOSSES IMPROVED IN RENFREWSHIRE.

The cultivation of moss is no where better understood, or carried on to better purpose, than in some parts of the county of Renfrew.

1. *Improvements on Paisley Moss.*

Several hundreds of acres of beautiful haugh land, on the side of the Black Cart river near Paisley, are unfortunately covered with moss, formed over immense numbers of trees, oak and fir, which had grown on that plain; and been cut down by human art, as appears from the roots yet entire, in the position in which they grew from the subsoil. The ground being nearly level, the moss is soft, deep and rough. In some places it is twenty feet deep, and produces nothing but heather, and the worst of moss fogs, on the surface.

Some parts of this moss nearest to Paisley was burned, and yielded some crops of corn about the middle of last century. It appears that burning had been much practised on this moss, for the *Bryum Purpurium*, which never fails to rise on burnt moss, abounds in some parts; and some of the tenants, to procure a more improveable soil than the cinders of burned moss, and a richer herbage than the *Bryum*, have trenched the surface. The bad effects of burning had been discovered long ago, and the Magistrates of Paisley prohibited it on the mosses which belonged to the community.

Cultivation was begun on this moss about twelve or fourteen years ago on plans much more liberal. Several tenants have cultivated small patches on improved plans, but I shall confine my remarks chiefly to what has been done by Andrew Moodie, Esq. Mr. Bell, and Mr. Kerr.

Mr. Moodie, in 1799, took a lease for nineteen years, of about seventeen acres and a half of the worst flow-moss, at one pound fifteen shillings, or two pounds, per acre. He divided that piece of moss into small lots, of an acre and a half or two acres, round each he cut an open trench to serve as a drain and a fence. He formed his ridges about twelve yards broad, with a deep furrow between each. This was all the draining attempted in a moss as level, wet, and soft as any in Scotland. So far from adding to the drains he uniformly lessened the number and size of the ditches and furrows as he proceeded. After finding the bad effects of laying the moss too dry, all the cultivators of Paisley Moss have formed their ridges forty feet wide, and their furrows not more than nine or ten inches square.

Mr. Moodie delved his moss for the two first years, and having applied some dung and compost, he planted potatoes both years, which proved excellent crops. The third crop was oats, also excellent. Clover and ryegrass sown on the oats turned out a valuable crop. Oats were next sown without manure, and a dressing of earth and lime having been applied, another crop of oats was taken, and the moss again sown down with clover and grass seeds. Oats followed the hay. No part of Mr. Moodie's possession has ever been in pasture.

The first crop of potatoes on Mr. Moodie's seventeen acres and a half produced seven hundred and seventy-four bolls of good potatoes, which brought him four hundred and eighteen pounds six shillings and two-pence. From a small field he dug up potatoes at the rate of ten pecks per fall, or an hundred bolls per acre. In the year 1803, he reaped from two fields of about three acres, oats at the rate of seventeen bolls per acre, and which yielded fully twenty bolls of meal each acre. In the year 1805, he reaped from one field that had not received

manure for three years preceding, fifteen bolls of corn per acre. In crop 1806, on part of his moss which had not been manured since the fourth year preceding, Mr. Moodie reaped from two acres, two roods, and twenty-seven falls, thirty bolls of good oats, part of which he sold at one pound five shillings per boll, and the rest which he manufactured into meal yielded seventeen pecks per boll. The fodder of this crop was sold at thirteen pounds ten shillings. Mr. Moodie has sold part of his hay crops from this moss at above seventeen pounds per acre. From this piece of moss which will not exceed sixteen acres and a half of productive soil, after deducting roads and ditches, he has raised crop in six years of the whole field, viz. 1801 and 1806, with about eight or nine acres that were in crop in 1800, for which he has received upwards of One thousand eight hundred pounds sterling.

Mr. Bell has proceeded in nearly the same course of improvement as that followed by Mr. Moodie, in labouring and cropping his moss, and his returns have been no less abundant. His best crop of potatoes was fully sixty bolls per acre. He sold his clover and ryegrass at one shilling and sixpence, two shillings, and two shillings and twopence, and part of it as high as half-a-crown, per fall. In summer 1804, he took two thousand two hundred stones of hay, from five acres two roods and three falls of that moss. In harvest 1806, he sold his whole crop of oats at fifteen pounds per acre; and twenty-six bolls of good oats were reaped from one acre and two roods of that field.

Mr. Moodie and Mr. Bell have raised excellent greens, cabbages, cauliflowers, and celery from this moss.

Mr. Kerr has attracted notice by the liberality of his improvements on Paisley moss, and the success with which his labours have been crowned. His plans of operation have been nearly the same as those followed by Mr. Moodie and Mr. Bell, that have been detailed, and his crops have been little inferior to theirs. He trenched a part of his moss, but found that it rendered the soil too dry.

Several others have cultivated pieces of this moss, in all a-

bout three hundred acres; but many hundreds more acres still remain a barren waste.

James Baird, who occupies a small enclosure of this moss, pays for it at the rate of four pounds four shillings per acre of yearly rent. In summer 1806, he grazed on three roods of this moss a large milk cow, and cut and dried thirty stones of hay from what she could not consume. When Mr. Bell proposed to sublet his possession, he asked four pounds ten shillings per acre, and was offered four pounds four shillings of yearly rent. Mr. Kerr was offered two pounds ten shillings per acre for what he occupies.

Great praise is due to the cultivators of Paisley moss for the excellent example they have set before the public, in reclaiming a barren waste. I have never seen the cultivation of moss entered on with greater spirit, conducted with greater propriety, nor more valuable crops raised on that species of soil. It is evident that all the cultivators will reap considerable profit from their industry. The proprietors will be gainers, in getting their land returned at the end of a short lease worth forty times its former value; and the public will be also gainers. From sixty to an hundred bolls of potatoes, twenty bolls of meal, or four hundred stones of hay raised from one acre of flow-moss of the worst kind, are matters of national importance,

2. *Improvements of Moss at Hartfield.*

Robert Fulton, Esq. of Maxwelton, has, on his Estate of Hartfield, about six miles south of Paisley, improved an extensive range of moss with great spirit, and to as good purpose as any I ever saw. When he purchased that Estate, which extends to about three thousand acres, in 1789, the rental was then only four hundred and eighty pounds per annum.

About one-third of the lands were then arable, near one-third was uncultivated moor-land or hill-moss, and the other third part of the Estate was covered with moss. Part of this

was bent-moss covered with a close sward of coarse green herbage, but much of it was flow-moss of considerable depth. As part of all these varieties of soil were to be found in every farm, it is impossible to ascertain how much of the rental was raised from the moss, and how much from the arable lands. But from the best information I could procure, I believe the whole moss ground did not add one hundred pounds to the rental.

The lands being under lease, it was not till 1796 that Mr. Fulton could obtain possession of Hartfield Mains, where he instantly commenced his improvements.

The whole Estate was then under the rudest course of husbandry. Nothing was cropped but the small patches of arable land, and the moss and moor ground was devoted to pasture. There were few dikes, no made roads, and no plantations on the Estate. Mr. Fulton built, on a plain and convenient plan, a range of farm houses and offices, at Hartfield Mains, and erected similar houses for some of his tenants. He opened new roads in various directions, straightened the ridges, planted belts, and enclosed the lands. He has taught his tenants industry and improved modes of husbandry by his example; and by the liberality of his plans and fair dealing, he has found means to excite them to industry. A proprietor who wishes to improve his Estate, ought to hold out fair and liberal terms to his tenants, and stimulate them to make improvements, not on the fanciful and extravagant plans of theorists, no way suited to the soil and climate, but on a scale adapted to local circumstances. A little done by every tenant every year, soon amounts to a great deal over the Estate. These things once begun make gradual progress. Too much ought not to be attempted at once. Improvements should be brought on as it were piece-meal. The people enlightened by degrees, their prejudices and bad habits will in that case be gradually overcome, till they ultimately advance towards perfection.

This was the plan pursued by Mr Fulton. He did not bring north some ignorant self-conceited stranger, to talk of great things, run into blunders, throw away large sums on fanciful

and extravagant plans, impracticable in such situations, and in two or three years after throw up the whole in chagrin, and thereby confirm the prejudices of the country people. He pursued moderate and rational plans himself, and persuaded his tenants to attempt similar improvements. When these succeeded they served as a stimulus to further industry, till in a short time the tenants became active improvers, and the Estate was every year more productive and valuable. Few instances will be found of such liberal and well conducted improvements by one Gentleman, over an Estate so extensive, in so short a period, and without much outlay. Mr. Fulton only commenced his operations in 1797, and he has reclaimed five hundred acres of moss soil himself, while his tenants, by his example and influence, have reclaimed still more. One of his tenants, Robert Smith, in West Hartfield, has improved nearly an hundred acres of moss, to the best possible pitch, and enriched himself by that species of industry. Another farm on that Estate still under the lease granted by the former proprietor, at fifty pounds of yearly rent, was covered with moss of one kind or other, over more than half of its surface. Mr. Fulton had no powers to compel the tenant to make any improvement; but he persuaded him to cultivate some part of his mosses, and to excite him to industry, offered him considerable aid in enclosing and liming his farm. With these helps, and an excellent example before his eyes, he has reclaimed the greatest part of the moss and moor ground on his possession, enriched himself, and raised the value of his farm to upwards of three hundred pounds of yearly rent. Happy would it be for themselves, for their tenants and the public, if our men of rank and proprietors of all descriptions would pursue such laudable courses, and instruct their tenants to become virtuous and industrious. Had this Estate fallen into the hands of some of our Peers of the first rank, this tenant would have been trudging on in his indolent and slovenly habits, courting the favour of the Factor, by mean obsequious conduct. He would have been poor, and his farm worth no more than eighty or an hundred pounds of yearly rent.

Mr. Fulton cut some open ditches in the lowest situations, and formed his ridges with furrows between each, so as to discharge the surface water into the open cast. This was all the draining ever attempted at Hartfield, and neither Mr. Fulton, nor his very intelligent overseer, Mr. Forsythe, thought any further draining necessary.

The moss was generally delved for the first crop, in summer, and instantly limed at the rate of six chalders, Winchester bushel, which was brought to the field from the parish of Beith, at the rate of thirteen shillings per chaldar. Lime has been almost the only manure used on Hartfield Mosses. No part of them has ever been burnt.

When the surface was tolerably smooth, the first delving was sometimes executed at two pounds ten shillings; but levelling was paid for over and above that price, and in some places it cost as much more. The second delvings cost about one pound eleven shillings and sixpence per acre.

In the year 1801, Mr. Fulton had fifty-three acres of deep-flow moss in crop, for the first year, and seventy-seven acres under the second crop.

The first crop of oats, on black moss, when delved and manured with lime, has seldom yielded more than three or four bolls per acre, and on the flow-moss it was only from one to two bolls per acre. Mr. Fulton has commonly taken a second, and sometimes a third crop of oats with no other manure but the first liming, and these have always proved excellent crops. He has sometimes taken a crop of turnips or potatoes after the second or third crop of oats, and when he did so, he always took a crop of oats after the potatoes or turnips, and laid the field down to Hay. He has generally had twenty acres in turnip, and as much in potatoes every year. When cropped with either of these he gives about sixteen single horse carts of dung to each acre.

He takes always one crop of hay, and often mows a second year. The crops of hay have been generally good; often two hundred stones per acre the first, and about one hundred and fifty stones on each acre, the second year. *Barley* was sown once at Hartfield, and turned out a decent crop. *Pease*

were sown on one field of moss at Hartfield ; they grew well, but the harvest being rainy they did not seed to expectation. *Red Clover* has been sown, and done well for one year. *Rib Grass* has been much used, and found to be a valuable grass. *Early Oats* do best. Potatoes have been planted at Hartfield, in lazy beds, but they never turned out a good crop, and the ground always remained too solid below, and the soil shallow. He has often delved the moss, and then planted the potatoes, and had a much better crop than when he planted on the unbroken moss, and the after crops were also much better. He has also found this an excellent method of preparing moss ground for being planted with trees.

Mr. Fulton keeps generally sixteen or eighteen cows at Hartfield Mains, and rears about twenty calves every year, which he sells off when they are nearly ready to drop their first calves. From these he makes a considerable quantity of dung, which he augments by every means in his power. He has made moss compost on Lord Meadowbank's plan, but does not seem to go to work with great accuracy in preparing it. He uses a much greater quantity of dung in the compost than his Lordship directs. He has used it for his turnip crop, and found it equal to the best dung on the farm. He has prepared large quantities of moss for manure by mixing it with powdery lime, and has found it to be excellent manure, when well mixed, and often turned over. He approves much of rolling. The feet of cattle greatly injure the moss ground after it has been cropped, by poaching it in winter.

One field of twenty-four acres of deep moss, covered with heather, not worth more than one shilling and sixpence per acre, was delved in summer 1798, limed at the rate of six chalders per acre, sown with oats, spring 1799 ; and the crop sold at the average price of three pounds ten shillings per acre. Grass seeds were sown on this first crop of oats, and the hay crop, in 1800, was worth six pounds per acre. After the hay had been removed, twelve cows were laid on this field, and they brought two pounds each, which, with the hay, was a return of seven pounds per acre, for this crop. It was intended

for pasture, summer, 1801, but, by accident, was left for hay. The crop was worth five pounds per acre, and the after growth equal to twenty each acre. That field had been in pasture till I saw it, in April 1806, and though it got no other manure but the dressing of lime that has been mentioned, it could have been set for one pound fifteen shillings, or two pounds per acre, during a lease. It was limed in 1806, at the rate of four chalders per acre, and had been cropped with oats when I surveyed it in spring, 1807. The corn had a fine appearance early in summer 1807, and I understood turned out a very excellent crop. I went to Hartfield in spring 1808, but Mr. Forsyth, who conducted these improvements with so much credit to himself, having died the preceding winter, and his successor being from home at the time, I did not obtain the most correct information on the subject. This field was intended for turnip, with dung, in 1808, oats 1809, and hay the year following.

Another field of twelve acres of flow-moss, much of it fifteen feet deep, was delved in 1799, limed at the rate of the other field, and cropped with oats spring 1800, but yielded only a bad crop. In 1801, it yielded a medium crop, of about five bolls per acre. It was in 1802 made into turnip, with sixteen carts of dung per acre, and yielded an excellent crop of that root. The crop of oats, in 1803, was luxuriant. In 1804, it yielded two hundred stones of hay per acre. In 1805, it was pastured, and fed twelve stirks, which were paid for at the rate of thirty shillings each. The pasture was still better in 1806, and since that time.

I consider the improvements on the Estate of Hartfield to have been hitherto as well conducted, as any improvements on moss I have ever seen. The value of the land is not only increased in a surprising degree, but what is still better, these improvements have been conducted with such propriety, that they have not only defrayed their own expence, but yielded considerable profit, even during the time the improvements were carried on. The manner in which he has excited his

tenants to industry, is highly praise-worthy. Many proprietors think, that whatever they give to a tenant is lost. The tenants are afraid to improve their farms, lest it may induce some rival to offer a higher rent. From such narrow policy on the part of both, the cultivation of the land is not attended to; but Mr. Fulton has, by a well-judged liberality, removed these mean jealousies, and established that confidence which ought to subsist between every proprietor and his tenants, and he has had the address to communicate to them his own liberal spirit of improvement. The consequences are, they have enriched themselves, tripled the value of their farms, and set an example to all others worthy of imitation. These improvements are the more interesting, as the land reclaimed lies at a considerable height above the level of the sea.

3. *Improvements on Moss at Pollockshaws.*

Sir John Maxwell of Pollock has improved some moss on his Estate, to great purpose. An extensive range of land, north of the village of Pollockshaws, and east of the Castle of Haggs, was offered to the present tenant at one shilling and eightpence sterling per acre, for a lease, but he did not accept of the land on these terms. Some part of this field was bent moss, or moorish ground, which has been since improved, and is now rented at three pounds per acre. About thirty acres of that field was deep flow-moss, and considered as of no value. Sir John Maxwell, about the year 1800, caused this flow to be delved into ridges, about seven yards broad, and having laid on, after delving, a good dressing of lime, cropped the whole with oats. The crop sold, by auction, at from forty shillings to six pounds sterling per acre.

The next year the whole field was delved over, and turned up like garden ground (turn-spaded, as the country people term it), which cost two pounds ten shillings per acre, and being again sown with oats, it yielded a crop considerably better than that of the preceding year; but as it was not sold, the exact

value was not known. Grass seeds were sown on the second crop of oats, but the seed happened to be bad. The hay crop, however, was worth three pounds per acre. This field has been pastured ever since, and well worth thirty shillings per acre. At present the pasture begins to fail, and the moss plants to rise; if a moderate dressing of hot lime were laid on the sward, one or two crops of oats, probably worth eight or ten pounds per acre, might be obtained, and the future value of the pasture doubled. If that is not done, the moss plants will gradually return, and the richer herbage die away.

The moss of Dumbreck, or Govan, on that estate, is from six to sixteen feet in depth, and of an aspect extremely forbidding. Sir John Maxwell, about the year 1800, caused twenty acres of this flow to be delved into proper ridges, and having put on lime after delving, took a crop of oats, which was equal to five or six bolls per acre. The second crop was much better; the hay for the third crop was worth three pounds, and the pasture since, better than one pound per acre. It is now ready to be broken up, and that seems to be intended, for the whole field had been limed on the sward when I surveyed the moss in 1808.

I have seen different times, an extensive range of cultivated moss on the Estate of Southbar, a few miles north from Paisley, which had been reclaimed by Boyd Alexander, Esq. These improvements seemed to be interesting. But as I did not procure proper information as to the *modus operandi*, I cannot enter on detail. If I can spare time to survey this moss, and revisit those of Paisley and Hartfield, before this Treatise is published, I will give some account of them in an Appendix.

SECT. VI.

IMPROVEMENTS OF MOSS IN STIRLINGSHIRE.

Moss Flanders extends one of its wings to within an hundred and twenty yards of Rednock House, the seat of General Graham Stirling, of Duchry, and as that part of the moss was sixteen feet deep, extremely wet, soft, and of an unpleasant appearance, General Graham was anxious to render it productive if possible, and at any rate to give it a more sightly aspect. The charge of that improvement was by him consigned to Mr. Lauder, a very respectable and intelligent farmer; and he has in the course of nine years reclaimed about seventy acres of that flow, to the best purpose, and at a small expence to Gen. Graham. The first operation was to cut deep drains on the verge of the moss to carry off some powerful springs which arose from the higher grounds, and spreading over the surface of the moss, kept it soft and wet. Beside these, open trenches were cut round fields of convenient dimensions to serve as fencoes, and to receive the water from the furrows. These are all the draining attempted at Rednock Moss.

The cultivation was begun on the plan recommended in the Swinridgemuir Pamphlet. But Mr. Lauder abandoned that plan for one of his own inventing, which merits attention.

The surface of the moss having been relieved of moisture, and some of its greatest inequalities smoothed, it was left to consolidate for a season or two. It was next ploughed in the time of summer drought, and exposed to the weather for two years, after which it was, during the summer, ploughed and harrowed different times, levelled and pulverized as much as possible, and formed into broad level ridges; and about thirty bolls of hot lime, (Linlithgow wheat measure) laid on the fallow; after which it was ploughed for the seed. All these operations were carried on during the drought of summer; the field lay exposed to the rains and frosts till next spring, when it was

sown with oats. The first crop has generally, when the moss was prepared in that manner, been excellent; from five to twelve bolls per acre according as the soil had been pulverized.

When the soil had been well reduced before cropping, grass-seeds were sown in the first crop. But if the soil was not completely prepared, a second crop of oats was taken before the field was turned into grass. One or two crops of hay were taken, the field pastured two years, then ploughed without further manure, and sown with oats, which generally yielded eight or nine bolls per acre. I would rather have limed on the sward before the second ploughing. The next crop was turnip or potatoes, with a small quantity of dung; then oats, and sown down with grass-seeds.

When I surveyed these improvements in August 1808, I found part of the moss in all these stages of preparation and crop, and all the crops were excellent. About five acres of oats the first crop, where the moss had not been sufficiently broken and pulverized, was equal to five bolls or so per acre. A field of the same extent, in the second crop of oats, had not less than nine bolls per acre. About twenty acres were in oats of the second rotation, and indisputably one of the most luxuriant crops of oats I saw on my tour from Edinburgh to Loch Crinan. I saw many stalks more than six feet long, and bearing near three hundred grains each.

Part of this flow next to Rednock House had been cropped three or four years, and then laid down in grass, in the form of a smooth land without furrows, about the year 1801, and when I saw it in 1808, I considered it equal to the best pasture in the County of Stirling.

A considerable number of drop-trees have been planted in this part of the moss. Oaks, Elms, Ashes, Limes, Birch, Spruce, Larch, Firs, Elders, Beech, &c. and all doing well. Some Limes and Elms that had been transplanted after they had attained the thickness of a man's leg, are now growing luxuriantly in the moss, extending their tops like umbrellas, and great ornaments to the field. I wish this practice were much more general. Some belts of trees have been planted and are

doing well. They grow best where the drains on the sides of the planting are deepest.

Mr. Lauder has now taken in lease the greatest part of the moss that has been improved, and a large tract of that which has not been broken up; and on this he has begun to act with spirit. If he go on for nineteen years more in the manner he has done for the last nine, he will add several hundreds of acres of productive land to General Graham's Estate, and I trust many hundreds of pounds to himself, the well earned fruits of his industry. I would recommend to every proprietor and possessor of moss, to survey the improvements of that soil carried on at Rednock House. Those that are industrious, or willing to become so, will find there a pattern worthy of their imitation; and the indolent and niggardly may read a reproof that ought to sting them with remorse.

James Hume, Esq. an intelligent and respectable agriculturist near Dunbar, having purchased a farm at Linton, in the County of Peebles, an hundred acres of which was covered from four to ten feet deep with wet flow-moss of the worst quality, he began about 1806, or 1807, to plough, lime, and crop some part of it on the plan pursued by Mr. Lauder, and his success in these operations has answered his most sanguine expectation. As he has uniformly pursued Mr. Lauder's plan, as detailed above, in fallowing, manuring, and cropping the moss, it is not necessary to repeat it here. When I surveyed these improvements in June 1811, I found that the whole hundred acres of moss had been fallowed, limed, and cropped during the last four or five years, except one field of about twelve or fifteen acres then under fallow; and that the crops of oats, some of them the first, and others the second year, had a more promising appearance than any in that neighbourhood. Some part of the moss which had been turned into pasture, after yielding two crops of oats, had an excellent sward of grass, except where it had been injured by the lodging of the corn.

This moss had in all cases yielded Mr. Hume a fair crop, and in some instances the oats had been uncommonly luxuriant. Part of the crop had been injured by the harvest frosts; but

some of it had produced as good grain as any in that County. A part of this moss had been burnt after being fallowed, and, as might have been expected, yielded the best returns; but even that which had not been burnt has yielded fair and some of it weighty crops. I have stated my opinions on the propriety of that operation already, and need not repeat them here. The only manure that has been applied to this moss has been lime.

Few instances will be found in any part of Scotland, of an hundred acres of the very worst of flow-moss, being reclaimed in so short a period, and to as good purpose. Mr. Hume having seen in some recent publications, that such mosses as that which disfigured his Estate had been reclaimed, he, in company with his Agent, Charles Oliphant, Esq. W. S. who acts as Factor to several Gentlemen, made a tour of the counties of Lanark, Air, Renfrew, Perth, &c. to see with their own eyes, what had actually been done, learn the *modus operandi*, and the success that had attended the different operations. Mr. Hume found, that under all the circumstances of the case, Mr. Lauder's plan was best adapted to his situation; and he has adopted it with spirit and great success. Formerly the greatest part of that moss was not worth one shilling per acre of rent, and beside the value of the crops of oats that have been taken, which I am confident must have nearly redeemed the expence, the whole moss will in future, even in pasture, give thirty shillings per acre of yearly rent; and after three or four years pasture, it may, with a moderate dressing of lime, yield the most luxuriant crops of good oats. In a word, it will, if properly treated, turn out the most productive land in that neighbourhood. Such instances of industry deserve to be recorded, and I trust they will soon be imitated by many other proprietors.

S E C T. VII.

Improvements of Moss in Perthshire.

Sometimes the moss is floated off by means of water, in order to come at the subsoil on which the moss rests. This is a mode of cultivation somewhat different from those which have been described. It is not properly an improvement, but rather an extirpation of moss. This however is only practicable in a few situations; and it ought never to be attempted, but where the superior value of the subsoil is equal to the expence of floating off the moss-earth.

The most masterly undertaking of this kind ever attempted in Britain, or probably in the world, is that which was projected and begun on the Estate of Blair-Drummond, by the truly patriotic Lord Kaimes, and which has been successfully accomplished by his son, the present Mr. Drummond. Many thousands of acres of beautiful haugh land, situated on both sides of the river Forth, above the bridge of Stirling, are most unfortunately covered with moss, from three to fifteen feet deep. This extensive vale had, in former ages, been covered with growing wood, part of the "*Sylva Caledonia*," mentioned by Tacitus. The innumerable trees which composed that wood are now found under the moss, lying by the roots from which they sprung, and these roots are also found in the ground, with their shoots and tendons far extended in the clay, in the very position in which they grew. That the cutting of this wood gave birth to the moss which now covers it, and the beautiful vale on which it grew, cannot be doubted. And it is equally clear, that the Herculean labour of cutting down these extensive forests, has been performed by the Romans. The roads (evidently Roman works) made through different parts of this extensive valley, upon the surface of the clay below the moss, the Roman stations yet entire in its vicinity, and the Roman utensils found under it, prove the cutting of these woods to have been

performed by that enterprising people. About fifteen hundred acres of this moss forms part of the Estate of Blair Drummond. Being flow-moss, very deep, of small value as a soil, and the subsoil being a strong rich clay, Lord Kaimes, that bright ornament of his native country, planned the scheme of floating off the moss, by raising a stream of water from the river Teath, in a regular formed canal to the Forth; and by this means, to relieve the rich clay soil from the huge load of superincumbent moss, so as it might be cultivated and rendered productive.

For this purpose, a wheel was constructed on the Persian model, which rises from the river, and discharges into troughs about twenty feet high, upwards of three thousand pints of water every minute. The water so raised, being carried to the moss, near two miles distant, is equally divided among the moss tenants, who store it up into reservoirs cut into the solid moss, until it be convenient for them to use it. A regular canal, about two feet wide, and eighteen inches deep, being formed on the surface of the clay, at the foot of the moss brae, the water is let into that canal from the reservoir, and the moss being dug up with spades, is thrown into the canal, which floats it into the river Forth. A break or dass of the moss, about ten feet broad, from the side of the canal, is usually taken in, and when that is dug down to the clay, and the moss floated off, a new canal is formed at the bottom of the moss brae, and a new dass or break of the moss dug up and thrown into it. The average distance to which the moss is thus thrown, from the spade into the canal, is five feet; yet when the digging up the moss, and throwing it into the canal at that average distance, is undertaken at a farthing for each cubic yard, the labourer will gain upwards of two shillings sterling per day. As a cubic yard of moss weighs upwards of ninety stones, a labourer will dig up in one day, and throw from his spade, to the average distance of five yards, about four thousand five hundred stones weight of moss-earth.

The wheel was erected, and the water brought to the moss,

at the proprietor's expence. The moss has been parcelled out in small lots, of eight acres each, on leases of thirty-eight years, and the tenants were mostly Highlanders, who had been turned out by their landlords, when the lands they occupied were converted into sheep-walks. The proprietor gave each settler a quantity of meal, with timber, and some further aid in building a house. The rent was low at first, but rises considerably after a fixed period. The colony began to be planted about the year 1768, and it now contains near a thousand souls, who, in general, live very comfortably, in neat small houses, mostly built of brick. Near five hundred acres of this moss have already been dug up to the clay, and carried off in this manner. As the average thickness of the moss is probably about eight feet, no less than 789,333,000 cubic yards of moss, weighing upwards of 71,839,970,000 stones, must have been dug up, thrown, on an average, to a distance of five feet, and carried off by the artificial stream of water!

From the lands thus cleaned of moss, between two and three thousand bolls of grain are now raised annually. Sixty horses, and between two and three hundred cows, are now supported upon a piece of land, which formerly did not yield a penny per acre of yearly rent. Great, indeed, is the honour due to the worthy and venerable patriot who projected the scheme, that has relieved so many of his fellow-creatures from misery, and taught them that industry by which they have enriched themselves, and greatly benefited society. The patriotism of the father shines conspicuous in the son, who, besides the enlargement of his rent-rolls, has the singular felicity of seeing his colony increase daily in wealth and happiness, by pursuing the paths of virtuous industry, which he and his father have opened to their view. Such consolations do not fall to the lot of many. I should covet the felicity which Mr. Drummond must derive from a survey of his colony infinitely more than I would do the whole labours and achievements of Mr. Pitt, or of Buonaparte. I much doubt if either, or both of them, could ever survey their works with the degree of plea-

sure which that gentleman must feel, on viewing the people he has rendered happy, and the service he has done to society.

Dr. Walker, in his Essay on moss, so often quoted, seems to have entertained the same sentiments with me on this subject, p. 83. "This is a domestic conquest, far preferable to one of a foreign nature. If this is not patriotism, one may be at a loss to know what patriotism is. The achievements of a warrior in the field may have a dazzling appearance, but they cannot, in the eye of reason, be accounted equal to this." And at page 104th, he says, "It is not easy to forget one of the last visits paid by the worthy Lord Kaimes, to his tenants in this moss. They flocked around him, the men, their wives, and their children, as to a father and benefactor. Not like other tenants, who are apt to extenuate their profits, they were anxious to show their beneficial crops, and how much they had gained. This was their comfort and his delight. But all this arose from his own original idea of rendering these honest people, to a certain degree, independent, and, consequently, industrious and happy, highly useful to themselves, to the public, and to his own property."

SECT. VIII.

Improvements on Moss in Argyllshire.

It must be gratifying to every patriotic mind, to know that the spirit of industry which begins to appear in other parts of Britain, has also found its way into the remote and rugged regions of Argyll. The inhabitants of that district will, I trust, become as famous in agriculture as their ancestors were in arms, when they set the Roman Legions at defiance.

Neil Malcolm, of Poltalloch, Esq. purchased several years ago, the Estate of Duntroon, situated at the head of Loch Crinan,

and resolved to make that place his chief seat in Scotland. Several thousands of acres of the lowest situated land, near the head of Loch Crinan, is covered to a great depth with moss of very small value. As a wing of this moss lay near to a place where he intended to build his house, Mr. Malcolm became anxious to reclaim some part of the dreary waste. To conduct that and his other agricultural improvements, Mr. Malcolm engaged Mr. James Gow, who had been bred a farmer under some of the best improvers in Scotland and England, and who had seen experimental moss culture at Trafford Moss.

Mr. Gow's first care was to drain off the powerful springs which burst from under the rocks and dry hills which surround the moss. Some of these springs were so copious, that the first drain he opened, of only an hundred and fifty falls in length, still continues to discharge, during the greatest drought, half a ton of water every minute. He opened drains wherever he found springs, and cut open trenches round every field or subdivision, to serve as fences, and receive the water from the surface. These are all the drains that have been made.

At first he formed his ridges of moderate breadth, and raised in the centre; but he soon saw the propriety of forming them broader and nearly level. He never makes them less than forty feet, and sometimes more than an hundred feet in breadth, and the furrows about sixteen inches square. Having cut his bounding and division fences in the shape of open trenches, he delves and levels the whole field, giving some declivity towards the open trenches. The delving and levelling costs two pounds thirteen shillings and fourpence per acre. He next cuts out the furrows, throwing the moss taken from them into the lowest places of the field, and raising the ridges some little in the centre.

When he first began the moss improvements, he planted potatoes in the lazy-bed form, with dung for the first crop; took oats for the second, and sometimes he took a second crop of oats, and then turned the field into grass. He has raised potatoes and turnip in drills, and oats or barley next crop. Most of these crops have been excellent. Twelve bolls of oats

per acre was no more than a medium crop at Duntroon ; and the turnip and potatoes were abundant, and of good quality. The manure laid on the moss was lime or shells ; but when either potatoes or turnip were planted, some dung was applied. Seaweed and coral shells have been sometimes used, but hot lime has been the chief manure. Several hundreds of acres of this moss have been improved with lime as the only manure.

For several years past, little of Duntroon moss has been cropped. The plan now pursued is to delve and level the field, leave it exposed to the weather for about two years, then half delve it again, completing the levelling, and making the whole surface as smooth as possible. A good dressing of hot lime is then spread over the whole in the month of June or July, and grass-seeds sown about a month after.

When the moss has been laboured and manured in this manner, a crop of grass springs up next year, and by the second summer, the whole surface is closely covered with a fine sward of rich grass. For the first and second year it requires to be pastured with sheep only, but afterwards it will support the feet of either horses or cows. The greatest part of the moss that has been reclaimed at Duntroon is now pastured with sheep. This is not from necessity, but from choice. I should have rather preferred cows on such fine pasture.

I was much satisfied to see, that from five to six hundred acres of the deepest and worst moss to be any where met with, has already been reclaimed and converted into as good pasture as any on that extensive Estate. I do not know what rent such land would bring at Loch Crinan, nor the profit raised from the sheep that pasture it ; but I am certain, that if it were situated in either of the counties of Lanark, Air, or Renfrew, it would bring upwards of two pounds per acre. These five hundred acres are now in an excellent condition for being limed on the sward, and put under a second rotation of crops. I am confident, that if these fields were limed at the rate of sixty or seventy bolls per acre, and ploughed after the lime has remained a year on the sward, that whole moss would yield two crops

of oats, of ten or twelve bolls per acre, and the grass improved for several years to come.

Beside these, near five hundred acres more are begun to be improved, and will, in a few years, be equal to the other.

Thorn hedges have been planted on the sides of some of the open trenches, and they have grown well where they have not been eaten by the sheep. A few belts or clumps of trees would be a great beauty, and of real service on this moss. Even a few Elms, Limes, or others, put in as drop-trees, would greatly ornament that level field.

Mr. Malcolm has carried on these improvements with a degree of spirit seldom to be met with; and in so far as I have been able to discover, with great propriety.

In a letter he wrote me, he says, his out-lay on these improvements has been considerable, and more than he thinks will be speedily refunded. That some errors may have been committed in an improvement so extensive, in a quarter so remote, where every labourer is ignorant and prejudiced against the undertaking, where every thing was to begin, and on a subject so little understood any where, is no way surprising. I understand that no distinct account has been kept of the expence of the moss culture separate from other improvements going forward there on a liberal plan, and a large scale. But I cannot perceive any waste of labour in the cultivation of the moss, and I am convinced it should answer for itself.

SECT. IX.

Improvements of Moss in Caithness.

When a native of South Britain, or one from the improved districts of Scotland, looks at the rugged and mountainous districts of the West Highlands, he will be surprised to find that the cultivation of moss should have been attempted under such

an inhospitable climate. But his surprise will be greater when he meets with cultivated moss on the north side of the Ord of Caithness; not near the level of the sea, as at Duntroon, but on the skirts of hills in five hundred or six hundred feet of altitude, in the stormy regions at the extremity of the Island. The very attempt at cultivation in parts so inaccessible, and where manure cannot be carried, conveys a severe reproof to every proprietor of such soil in situations more accessible, where manure abounds, the produce is nearer to market, and brings a better price.

The improvements in this unfavourable region have been planned and carried into effect, by the Right Honourable Sir John Sinclair, President of the Board of Agriculture, and whose exertions to promote every branch of rural economy, and national improvement, have exceeded those of every other man, in any age or country.

The Ord of Caithness is sufficient to appal a traveller of ordinary courage, to pass over it by the public road. Not one among a thousand of the most enterprising cultivators would have attempted the improvement of moss in such regions, and under so many disadvantageous circumstances. Sir John Sinclair is not to be deterred by the agitation of the Moray and Pentland Friths, their spray bedewing the mountains, nor by the force of the Hyperborean winds, from extending his improvements under the greatest apparent disadvantages.

The piece of moss which the intelligent, industrious, and Right Honourable Baronet has selected for cultivation, is situated on the skirts of a bleak mountain, several hundred feet above the level of the sea, and where the exposure is towards the north east. It is in a sort of medium state between bent and flow-moss, the heather long, and the aspect dreary. The plants it produces are those that grow on flow-moss; but from the steepness of the ground, the facility with which moisture escapes, and from the beating of the rains, spray from the sea, permeable subsoil, &c. the moss is remarkably firm and solid, and generally from one and a half to two and a half feet in depth. I was much surprised on seeing in the newspapers, a copy of Sir

John Sinclair's Letter, saying, that the moss could be ploughed in winter, even after the sward had been pared and burnt. But on surveying the moss myself in August 1805, I found the plough at work, drawn by three horses, ploughing a second or third furrow, after the sward had been removed, in time of the wettest weather, and without the horses miring.

As the shore is scarcely accessible for boats, and if they could come in, manure could not be carried from the shore to the field, otherwise than on horses backs, Sir John had no other mode of manuring this moss than by paring and burning. I have already stated my objections to this mode; here, however, it was matter of necessity, for, except at the lower parts of the moss, neither sand nor clay can be found under it. In the upper parts of the field the moss rests on rotten rock, such as would be used in making a road. Too much burning will be injurious, as it will exhaust the moss, and reduce the ground to absolute sterility, until moss be again formed over it some thousand years after. The top dressing of clay, or earth of any kind, wherever it can be come at, or brought on the moss at any reasonable cost, and burning more sparingly, were the only improvements I was able to suggest on seeing the moss.

The Right Honourable Baronet carried north a party of men from the Cambridgeshire Fen-country, with fen-ploughs, and English tools. The ploughs I have already described; with the conduct of the men I have nothing to do. The cultivation, however, made no progress under their direction, till Mr. James Anderson, in Ausdale, a native of the Highlands, and one of Sir John's own tenants, took charge of the improvement, and conducted it on more judicious principles than the strangers from the South had done. That very intelligent Gentleman was well acquainted with every local and relative circumstance; and though he could not manage the fen plough, with the same dexterity as they did, his better education and good sense rendered him superior to the whole party.

When I surveyed these improvements, I found about fifteen acres in beer and oats, and both were superior to medium crops.

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Ten acres were in turnip, and had then (the end of August) a promising appearance. Mr. Anderson wrote me since, that they turned out sound and good, but not the weightiest crop. Part was cropped with cole-seed. An extensive field had yielded a medium crop of hay, part was in pasture and part in summer-fallow; in all about an hundred acres reclaimed from the value of a penny to fifteen shillings per acre.

This is only a mere patch on the skirts of the Ord, yet the appearance of a fine green cultivated spot in the middle of such extensive ranges of bleakness, is extremely pleasant, and shows what may be accomplished by industry. If such efforts have been made with success, in regions so remote, so forbidding, and where so many obstacles present themselves, what ought not to have been long ago achieved on the moors in the shires of Lanark, Renfrew, Air, &c. where millions of acres are to be found, much more propitious to cultivation, and where coal and lime abounds? yet these remain in the hands of indolent tenants, at a trifling rent, altogether neglected by the proprietor, except as to the *Preservation of the Game*.

As the publication of this Treatise has been so long delayed, it was my intention to make another Survey of the improvements in Airshire, Renfrewshire, &c. that have been described, to enable me to bring down the Journals of them to the present time. But the Survey of Airshire has occupied my attention so long, and I am now so much engaged in drawing up three weighty Chapters of the General Report on Scotland, to be laid before the King and both Houses of Parliament, and in the Survey of the County of Bute, that I have not been able to make these surveys. If I can overtake them before the printing is finished, I will mention the results in an Appendix.

CHAP. VI.

OF THE OBSTACLES TO THE IMPROVEMENT OF MOSS, AND THE
MEANS BY WHICH THEY CAN BE REMOVED.

IT has been shown in the introduction, that the subject treated of in this publication is of very considerable importance. No less than the recovery of many millions of acres of this Island, which have either been totally lost, or reduced to less than a twentieth part of what would have been their value, if moss-earth had never grown over the surface; beside the climate being rendered much colder and damper. A subject so highly interesting, it might have been expected, would long ere now have attracted the notice of all ranks. Yet we find that few have paid the least attention to that substance. Neither the occupiers nor the proprietors of land, Philosophers, or Statesmen, seem disposed to pay attention to the intrusions of moss. The Highland Society have indeed done something to excite investigation into its qualities and uses; but I believe the Board of Agriculture have not yet been able, from the pressure of other business, to turn their attention to moss.

The inattention of all ranks to a matter so highly interesting is truly surprising. Forests have been rooted out, lochs and swamps have been drained, encroachments have been made on the sea, by embankments at great expence; every thing has been done to spare the surface of the arable land, and recover it from every other intruder. But wherever the baneful substance moss has once fixed its seat, the soil is abandoned as to cultivation, and the possessor contents himself with its scanty and unpalatable herbage, diminished in value every year. No efforts are made to recover the soil, or so much as an inquiry

instituted if that can be done. Wherever moss has fixed its seat, it is as completely abandoned as to improvements, as if that part of the soil had sunk in the ocean.

When it is considered, that by the reclaiming of moss, several millions of acres might be added to the productive soil, the climate greatly improved, the whole Island rendered more productive, and the cultivator amply rewarded for his labours, the neglect must appear surprising.

As some share of blame attaches to the occupiers, the proprietors, men of science, and the Government, I shall take the liberty of mentioning how far each of these orders of society seems to me culpable in what regards the cultivation of moss.

SECT. I.

The obstacles to Moss culture arising from the occupiers of that species of soil.

IN tracing out the obstacles to that species of culture arising from this class in society, ignorance, prejudice, indolence and bad habits fall to be mentioned. It may appear invidious to expose the vices of any body of men. But when these are of such a complexion as not only to be injurious to those who labour under them, but to be hurtful to the whole community, delicacy ought to be laid aside. I do not know how a more important service can be performed to these individuals, and to the public, than by faithfully exposing their errors and prejudices, and pointing out how they can be removed. The following remarks are not intended to expose, but to convince and reclaim.

Ignorance of the genuine principles of agriculture, is the source from which all the errors and prejudices in husbandry proceed. The generality of the occupiers of land are in a great measure unacquainted with the general principles and laws of

nature, which are most intimately connected with their own profession. They learn to perform certain parts of agricultural labour, in the manner, and at the season of the year, that the same operations are executed by their neighbours. But few of them are at pains to inquire if these operations are susceptible of improvements, either as to the time or manner of execution.

They are generally ignorant of the mechanic principles upon which their implements of labour ought to be constructed. Hence that waste of power, and defective execution of labour, the result of ill constructed implements. Few of them know any thing of the general principles of vegetation, or the element on which plants are fed and reared. They never imagine that such an inquiry forms part of their duty, or is any way connected with their interest.

Manure is an article of the first necessity in agriculture, yet few of the lower orders of farmers are properly acquainted with its nature and qualities, or how its fertilizing powers may be diminished or increased. Hence that slovenly treatment of manure, which in many cases renders it of small value from what it would be under a more proper management. Many of our farmers are contented with the dead-body of manure, while the nutritive qualities are exhaled by the sun, or dissipated by the rains. All of them know that their labours on the soil, and the manures they apply, are more efficacious at one time than they are at others, but they seldom know, or even inquire into the causes which produce such abundance in some cases, and such scanty returns in others. They do not inquire into the principles of vegetation, the food of plants, or the qualities of manure, but enthusiastically attribute their good or bad crops to the favour or frowns of heaven, and have recourse to prayers and religious exercises to procure more plentiful returns.

Ignorance of the uses and qualities of moss forms a powerful obstacle to the improvement of that species of soil; and experience, which is best calculated to open the eyes of the tenantry on that subject, and remove their prepossessions, is yet in a great measure wanting.

Prejudice operates as another bar to the species of improvement here treated of. A spirit of enthusiasm which was raised about the time of the Reformation, and which has not yet been completely removed from among the lower orders, has been highly injurious to the interests of agriculture. They laid aside the improvement of the soil to make reforms on the church. Their attention was not directed to the breaking up of their mosses, but how to pull down the *Whore of Babylon*. The Reformation which served to promote agriculture in England, was highly injurious to that science in Scotland. In England it was begun by the Court, and the struggle between it and the clergy was soon over. The lower orders followed their superiors as a matter of course, but were never made parties, or their labours much disturbed by that great event. But in Scotland, the Reformation was begun by a few priests, who called the lower orders from the plough, to help them to carry it by force against the clergy and the Government. The peasantry once called to take a share in Reformation, have ever since continued reforming the church, to the neglect of their agricultural concerns. To this day the founders of churches or meeting houses, and the keen partizans of sects, will seldom be found among the improvers of moss, or any other soil. They generally spend their time in vending their own tenets, or the particular dogmas of their party; or what is still worse, in circulating calumny against the ministers and members of other parties. Such people are generally as much wedded to bad habits in agriculture, as they are to other nostrums. They would consider it a proof of levity to depart from the beaten path, and the good old way.

Indolence is another great obstacle to the cultivation of moss. Sloth supports the pleas of ignorance and prejudice, and pleads for "a little sleep, a little slumber, a little folding of the hands" in indolence. Moss ground has always been devoted to pasture with sheep; and the shepherds of Scotland, like those engaged in the pastoral life in other ages and countries, are borne down with indolence: they are out of temper, if you

only tell them that their farms are capable of being improved for grain.

There is generally attached to the sheep walks in Scotland, extensive ranges of ground, of such quality and so situated, as to be capable of yielding the best grain, with only a moderate dressing of manure, and being relieved from stagnant water on its surface. If the tenant of such a farm were bound to manure and crop, in the course of his lease, a part of such land, corresponding to the extent of the farm, and the means of procuring manure, and other local circumstances, the rent of the farm might be doubled every fifteen or twenty years, and the tenant enriched. I know many farms of from two thousand to five thousand acres, where one third, or one half, could easily be made to produce grain in abundance, and support a dairy stock. These farms are occupied with sheep, and with perhaps three or four milk cows: I would not advise any proprietor to change too speedily the stock and mode of farming; but were such a farm to be placed under my direction, I would bind the tenant to lime and plough for two crops, and lay down in grass from five to ten acres every year during his lease; by the third or fourth year of his lease, he might be able, on that improved ground alone, to keep three or four dairy cows, and to increase them to twenty or thirty by the end of the lease.

This improvement alone, would bring more rent by next lease, than all the farm gave during the former; and if the same course were pursued, till the whole ground that was capable of being ploughed was broken up, and brought into good grass for a dairy stock; that, independent of sheep and shepherds, which might still be allowed to loiter on the hills, would give five, perhaps ten times the present rent: but such improvements would require the joint attention of the proprietor, those who conduct his business, and the tenants, to carry them into effect. This is not the place to treat of the species of stock most proper for this or any description of soil. A mixture of stock is probably, in all cases, the most judicious: cattle of every description, especially those that are reared for

the southern markets, might be sent to pasture on the hill grounds in summer, and certainly the sheep ought to be permitted to come down to the glen and valley ground during the severe weather in winter and spring. The dairy stock should never be put to the hill pasture, but fed on the cultivated glens in summer, and in the byre on dry fodder and turnip in winter and spring. In many situations much excellent grain might be raised in the glens and straths between the hills: it would in some places be injured by harvest frosts; but when the springs and gutters were once drained, these become less frequent: the altitude of many of these straths is not too high for grain, and the soil washed from the hills is most excellent. But if grain should be lost in a bad season, or be of small value at any time, the soil might still be improved so as to produce hay, turnips, clover, &c. and corn would at all times grow on such soils, sufficient to fodder a dairy stock. Potatoes, cabbages, greens, flax, barley, and grasses, may be raised to perfection every year, and corn at least three years in four. But to return to the farmers:—

Much of their time is lost in attending fairs, races, rousps, weddings, and other such meetings, where the one half have no necessary business, where no rational amusement can be enjoyed, or comfortable accommodation obtained; where too frequently health is impaired, vice engendered, morals corrupted, and every sense of modesty and propriety of conduct lost. I have often seen the half of the inhabitants of a town and parish collected into groups, and remaining idle for several hours, merely *to see a wedding pass*, and three or four country lads wasting their horses, and putting their lives in danger to *gain the broose*, that is to get first to the wedding-house: others saunter away their time about mills, smithies, shops, and villages, collecting and relating the news and gabble of the neighbourhood, to the destruction of their own peace, and that of others. If the time that is lost in such unprofitable trifling were devoted to the improvement of moss, or other soil, it would add much to the comfort and wealth of the individuals so employed, and the prosperity of the nation.

A propensity to buy and sell cattle, is another obstacle to the improvement of the soil, and a great vice among farmers. The money gained in that trade by some knowing ones, and the roving mode of life, compared with the drudgery of labour, induce many to neglect their more honourable, and more important concerns, to deal in cattle. The generality of those who occupy moss and moor ground are infected with this vice. Too many of those who are seized with that mania, are not over-scrupulous as to their modes of dealing. Duplicity, or some sort of cunning near of kin to fraud, is frequently practised: few of them are much hurt at such conduct being imputed to them: their habits of industry are broken by that mode of dealing; an aversion to labour is contracted; they neglect their farms and families; acquire vicious habits, which unfit them for the performance of relative and domestic duties. Their business being generally conducted in dram-shops, they frequently acquire a relish for spirituous liquors, and injure their health by the want of regular food, when they attend fairs and markets. The best antidote against that species of vice is, for proprietors of land, and their doers, to refuse to set farms to those who are infected with the mania of dealing in cattle.

But it is not the illiterate and prepossessed only, who are blameably negligent in the important concerns of agriculture.

SECT. VII.

Obstacles to Improvement arising from the Proprietors of Land.

THE proprietors of land, who have a permanent interest in their estates, are certainly much more interested in the improvement of the soil than tenants, whose right is limited to a few years; of course the degree of blame attached to their neglect is much greater. Sir John Sinclair observes, in his

view of the northern counties, Page 72, that "We are ready
 "to lay blame upon the lower class of farmers, and let them
 "take their share of it; but let us bear ours also: let us ac-
 "quit ourselves as a body, before we condemn them in
 "mass."

It is matter of regret, to every person who has the prosper-
 ity of the country at heart, that so many of the proprietors of
 land, especially those of the highest rank, overlook their duty
 and their interest, in what regards the improvement of the
 soil in general, and that of moss in particular. Happy would
 it be for themselves, their posterity, their tenants, and the na-
 tion, if noblemen, and gentlemen of extensive property, were
 only half as eager to promote the improvement of their estates,
 as many of them are to tread in the slippery paths of political
 ambition. Is it not surprising, that such proprietors should
 desert their estates, and all the pleasures and honours such
 a situation might confer, in order to enter the list with others,
 as candidates for court favour? The real honours and enjoy-
 ment to be derived by residing on their estates, surrounded
 and looked up to by their servants and tenants; teaching them,
 and being instructed by them, how to promote agricultural im-
 provements; how to increase the number and add to the
 comforts of the human race, are pursuits much more manly
 and patriotic than bowing at court.

The extensive domains held by men of rank were not con-
 ferred on them, merely for their own aggrandisement, to grati-
 fy avarice, or support extravagance. They hold their Estates
 as trustees for the mutual benefit of themselves and the pub-
 lic *. The land is the public stock, in which all the inhabi-
 tants have an interest. The proprietors are so many guardians
 of that stock, acting without controul indeed but for the bene-
 fit of the whole community, as well as for their individual in-
 terest. It is certainly proper for every proprietor of land to
 attend to his own interest as a primary object, in the uses to
 which he converts his property. But one who converts it to

* View of the Northern Counties, by Sir John Sinclair, page 170.

purposes inimical to the public good, is an enemy to the State ; and those who merely collect the rents without improving the soil, only hide the talent in a napkin, and thereby merit the doom of one who followed the same niggardly course.

A proprietor of land who resides on his Estates, lets his lands on reasonable terms, adopts moderate and rational plans of progressive improvement, calculated to better the condition of the tenants ; condescends to survey their operations, instructs and encourages them in agricultural pursuits, rewards their industry, and treats them with kindness and humanity ; will obtain the well-merited approbation of his tenants, his country, and all good men, as well as that of his own mind. Such a proprietor will be revered by his inferiors, respected by those of higher rank, and venerated by all. An increase of rents will be the least of his rewards. The consolation of having increased the number, and added to the comforts of the human race ; raised his tenantry from poverty and ignorance to knowledge, virtue, and affluence, will prove to him sources of present joy and permanent satisfaction.

But a proprietor who deserts his Estates, neglects the duties he owes to his tenants, leaves them to be imposed on by his servants—extorts rent beyond value—takes no pains to improve the soil, to render it more productive, or more populous, and the tenantry more comfortable—who, instead of instructing them in agricultural improvements and virtuous industry, contaminates their principles by his evil example, or that of his servants and retainers—who devotes his time and talents to mean and trivial pursuits—who is wrapt up in the contemplation of his own imaginary rank and dignity, justly deserves, and cannot fail to meet with the execration of his own people, the contempt of every virtuous and benevolent mind, and the never ceasing reproach of his own guilty conscience.

By a false etiquette, and a vitiated taste in the higher orders, all immediate communication between the great landholder and his tenants is broken off. Many of them would consider it below their rank to be seen conversing with their tenants. The factor is the only go-between, and he is seldom disposed

to make the parties acquainted with each other. Their connection is not now that of parents and children, or master and servant; but of two cold-hearted merchants from distant countries, trafficking through the medium of an interpreter.

I do not say that a proprietor is to be confined to his own Estate, or precluded from serving himself or his country in any other capacity. They have other duties to perform beyond the bounds of their own domains. But I will say, without the dread of being contradicted, that the improvement of the soil, and thereby adding to the number and comforts of the human race, are the first and greatest duties, and ought to be the chief care of every proprietor.

If a proprietor altogether neglect his duty and interest in the improvement of his Estate, it is not to be expected that those to whom he consigns the management, will care much for its prosperity. If the proprietor attend to nothing but the amount of his rent-roll, the Factor or agent will likewise attend chiefly to his own interest. The Estates of such proprietors are generally consigned to the management of Attornies, Writers, Accountants, &c. who know as little about improvements in agriculture, as they do about necromancy. They can buy, or pretend to buy, for their master, some interest in a Burgh, and in that way lavish as much of his money as would reclaim many thousands of acres of moss. But they have neither the capacity nor inclination to execute such improvements.

The leases usually granted are a mere jargon of barbarous style of the dark ages, no way calculated to promote improvements. They are fabricated by writers, or their clerks or apprentices, whose views are directed to legal forms, and who copy them from books of style, or such forms as they have been accustomed to write. They are frequently a mere hodge-podge of Law, and jargon of style, huddled together with little judgment, and almost void of meaning. They seldom serve any other purpose than to fix the amount of the rent, and endurance of the Lease. The tenants find it their interest to trust more to the good will of the powers that be, than to the stipulations of their leases.

In a country where great diversity prevails in soil, situation, and state of culture, not only in different counties, but generally on every Barony, and sometimes in every farm or field, every different farm should be laid under a course of treatment suited to its own particular state. It must be as absurd to subject the farms in a country, parish, or estate, to one course of management, as for a physician to administer the same medicine to all his patients, and put all of them under one regimen. Absurd as it certainly is, that is the course generally followed. The difference in their farms does not proceed from any diversity in soil, climate, or other relative circumstances, but from the system of styles used in the office where the tacks are scrolled and extended. The tack is not framed to suit the peculiar state of the farm, or the improvements of which it is susceptible, or stands most in need, but is modelled entirely from the style book in the office. No matter whether the farm be large or small, improved or in a state of nature, consisting of fertile haughs in low situations, or of mosses and moors on the highest hills; wherever it lie, or whatever state it may be in, is all the same to the clerk who scrolls and extends the tack. The style book comprehends the sum of his knowledge, and the utmost bounds of his duty. Further he knoweth not.

The tacks granted on many of the large Estates are as much the same as the Schedules for the Income Tax. On the Estate of the Duke of Hamilton, where I reside, though all the diversity of soil, situation, state of culture, and every circumstance that can render a diversity of operation necessary, may be found, a hundred or two of tacks are printed at a time, with blanks to insert the name of the farm and tacksman, the rent he is to pay, and the commencement and termination of the lease. These lie in the hands of the Factor, like so many ale licences, or whisky permits, to be filled up when a bargain is concluded. They are by no means void of matter. They contain many long clauses about labouring and cropping, even where the farm is nothing but a sheep-walk; about upholding fences, though there is not one single enclosure fencible, on the extensive Estate of Avendale and first on the Duke-

dom; about plantations, though there never was the fourth part of an acre planted on that Estate; about mill multures, even in Store farms, and about minerals, whether any have ever been discovered in the farm or not. They are the same in lands that bring four pounds of yearly rent, and in those that are set below fourpence per acre; in those that are improved, and those that remain in a state of nature; in those that are capable of great improvement, and in those where none can be made. Of course the tacks on that Estate remain dormant, so far as regards improvements; and serve no other purpose but to fix the rent and term of endurance. The tenants do not recommend themselves by launching into improvements; but take care to keep in terms with those that are in power.

The interest of agriculture, and that of society, are frequently much injured by the factors and agents on large estates, setting large tracts of land to tenants who subset part of their possessions to others, thereby raising themselves as middle men between the proprietor, or rather between the factor and the possessors. I am not here deciding on the size of farms, or the advantages or disadvantages to society of those which are large or small. But whatever be the size of farms, no more ought to be set to any tenant than is convenient for him to occupy. I know no description of men more oppressed and worse treated, in the western counties, than the subtenants, unless it be the tenants of the small proprietors. They are generally poor and oppressed: on pretence of saving expence, no tacks are entered into, and whenever they better the condition of their possessions, or the value of the land rises, they are turned off. The late rises in the value of land, produced many instances of that species of fraud, among the principal tenants and the proprietors of single farms of late years. Yet the conductors of Estates continue to raise one favourite tenant over several smaller ones, from whom they draw considerable lordship. Subsets are generally prohibited in the tacks, but like other parts of the contract, that clause remains a dead letter, unless the tacksmen be on bad terms with the factor. A cotter on each farm, and two or three on

those that were large, if put under proper regulations by the proprietor, might be of great service to the interests of agriculture. But to wink at subsets, or encourage them merely for ease to the factor in collecting the rent, is to sanction oppression and injustice, highly injurious to the interest of agriculture.

It is, no doubt, easier to point out faults than to direct to proper remedies. In those here complained of, the whole evil proceeds from the proprietors neglecting that most important part of their duty, and of their interest, attention to the improvement of their estates, and leaving them to the management of men unqualified or inattentive to their improvement.

To remedy these evils wherever they prevail, I would recommend to all the proprietors of large estates, that beside their agent who conducts their law-suits, keeps their charter-chest, grants charters to vassals, canvasses in politics, &c. and factors to uplift their rents, that they should appoint a man bred up to, and every way conversant in all the branches of husbandry that are suited to their estate, and of the improvements of which it was susceptible, and a man of such integrity as would not join with any other servant to compromise the interest of the proprietor. His business should be to survey every farm when out of lease, point out what improvements it wanted, what part of these ought to be executed by the tenant, to what species of stock and course of cropping it was best suited, and lay down a plan of operation suited to that individual farm, in the state in which it then was.

For instance, if the farm were chiefly moorish ground, inquiry ought to be made if the pasture could be improved by surface-draining; if belts or clumps of planting could be raised to shelter the stock; what part of the lower grounds could be drained, manured, and brought into crop, or good dairy ground; how much of it should be broken up and reclaimed by the tenant annually, without exhausting too much of his capital, or preventing him from raising a fair rent from the farm, while these improvements were going forward; how

the manuring and cropping of what was to be broken up was to proceed, so as to render it as productive as the nature of the ground would admit, without any enormous advance, and with the certainty of the improvement proposed defraying every outlay, and ultimately increasing the value of the land. For I would not confer the name of improvement upon an operation that did not refund the expence in a few years, and double the value of the ground in all time coming. In all cases, but especially in the improvement of farms of the description here referred to, I would recommend a slow and easy, but constant and gradual course of improvement. If four or five hundred acres in one farm, were found capable of being rendered productive of grain, and converted into arable land, I would bind the tenant to break up the half of that in the course of one lease of twenty years, leaving the other to be reclaimed in the same gradual manner. This mode of improvement does not derange the former mode of occupation, nor require any material advance of stock; and the one end of the improvement furnishes the means of accomplishing the other.

In like manner, the land-grieve ought to condescend upon the nature and extent of the improvements suited to every other species of soil. Improvements ought not to be left to the arbitrary will of indolent tenants, who, if they can raise their rents by the most slovenly practices, will seldom be disposed to adopt more liberal plans. I have often seen bad effects from the proprietor tying up the hands of his tenants too much as to cropping their farms; this ought in a great measure to be left to the tenant, under no other restraint than never to render the soil worse, but gradually to make it better. But the draining of springs, drawing and keeping up fences, straightening of land, breaking up of wild ground, moss, &c. ought all to be fixed in the lease, and care taken that the tenant perform them in terms of his bargain.

The plan of gradual improvement to be carried into effect during the lease being fixed, the next duty of the proprietor, or those entrusted with the management of his Estate, should

be to select a tenant, qualified to carry these improvements into execution, and to manage that description of land.

Nothing can be more injurious to the interest of agriculture, than letting farms to tenants that have not been trained up in the courses of husbandry, for which the particular farm they are to occupy are adapted. To employ a shepherd in drill-husbandry, or a ploughman in managing a sheep stock, is hurtful to the individuals, the proprietor and the public. *Ne sutor ultra crepidam* ought to be a maxim in agriculture, and in every other science. If Sir Ralph Abercrombie had commanded the fleet at the mouth of the Nile, and Lord Nelson, the army before Alexandria, we should not have had such glorious victories in either case.

Nothing is more common, however, than for merchants from behind a counter, weavers from a loom, or fleshers from their stalls, obtaining from factors, for a small advance, leases of farms, for the management of which, either for the interest of themselves, the proprietor or the public, they are altogether incapable. A shepherd, who has lounged on the hills under a plaid from his infancy, will be preferred to a grain farm, though the best farmer in Lothian had offered nearly the same rent.

But the business of the land-grieve ought not to terminate with the arrangement of the plan of improvement, and the choice of a tenant qualified to carry it into execution. By the present economy no attention is paid to the tenant during the lease, *but to uplift his rent*. If that is paid when due, and the tenant be sufficiently obsequious to the factor, no attention is paid to him or the farm, or the mode in which he treats it during the lease. But it ought to be the business of the land-grieve to survey every farm under his charge, four times every year, to see that roads, fences, and houses are kept in proper repair, the new ground, moss, &c. broken up and improved, drains cut, ridges formed, manure applied, and every improvement executed in terms of the contract entered into between proprietor and tenant, and to favour the tenants with his advice in their agricultural operations.

A land-grieve who would honestly and diligently discharge

these duties, on any large Estate where improvements are scarcely begun, would prove a blessing to the proprietor, the tenantry, and the public. A steady and conscientious discharge of these duties, for twenty or thirty years, would more than treble the rental of most of the large Estates I know. Especially where much of them is moorish ground, or approaching to moor, while at the same time he would be the means (if he acted with prudence and integrity) of instructing and enriching the tenants, beautifying and fertilizing a range of country, and benefiting the community.

But if this Land-grieve were to become the dupe of some other servant, act under his controul, and a partaker of his frauds and peculations—if his house became the office for the receipt of hens, eggs, game, and such presents from the tenants, or others with whom he transacted business for his master—if he became tacksman of coal and limeworks on the whole Estate, raised the prices so as to bar improvements, and both he and the factor, by such modes of dealing, realized large fortunes, while they contaminated the morals of the tenants, and all with whom they had connection by their dissolute lives; such Factor or Land-grieve would only prove a disgrace to the proprietor, a burden on the tenants, and a pest and nuisance in the country side.

Perhaps I shall be told that Land-grievances have frequently been employed by proprietors of large Estates, but few instances can be pointed out of their bettering the Estate to all the extent I have mentioned. That is certainly true; but the failure has proceeded chiefly from making a wrong selection of the person to conduct that business, and employing him in an improper mode of improvement.

When our Noblemen and men of fortune see the rich lands and luxuriant crops in the southern parts of the island, they do not attend to the change of circumstances, and impute the more abundant fertility to more skilful cultivation. The difference of altitude, of soil, climate, and state of cultivation are altogether overlooked. On entering into conversation with the improver,

he shows him "as how" all these fine crops are the fruits of his labours, and that with his fine implements and superior skill he could raise such crops any where. The wealthy proprietor, who, if he have studied agriculture at all, it was not on his own Estates, but in England, perhaps only in reading some well written books on the subject, listens to the plausible story, engages the stranger, and says to himself "now do I know that my Estate shall become productive, since I have gotten an Englishman to be my improver."

The stranger comes north with mighty promises, and the proprietor with elevated expectations. He brings with him, or gets made in Scotland, many fine implements unknown in these quarters of the island, and no way suited to the state of things in that part of the country. His operations commence on a liberal scale. But being a stranger to the climate, soil, and other relative circumstances which influence agricultural operations, he runs from one error to another, till his employer finding that his elevated expectations are not realized, and large sums thrown away on whimsical plans of cultivation, he abandons his improvements in chagrin, and thereby confirms the prejudices of all his tenants and neighbours. I do not despise the superior modes of improvement carried on in some parts of England. On the contrary, I would have every farmer to send his sons to England a few years to acquire further knowledge in agriculture, and to imitate on their return every improvement that was practicable in their native country. This would be productive of good; but I never saw much good result from bringing Englishmen to Scotland.

Another error generally run into is, making extensive improvements at the expence of the proprietor, with his own horses and men hired under the direction of a Grieve. Some land has no doubt been improved in this manner round the seats of Noblemen and Gentlemen, and the money sunk in such improvements is a necessary sacrifice to taste and elegance, worthy of their rank and fortune. But from the manner in which some of them have been executed, the proprietor had better have purchased the land so improved. I could easily

point out instances where these improvements have cost more than could be obtained for the fee-simple of the land.

This has prevented many proprietors from extending their improvements farther than a few fields round their castle. Rather than carry these over their estate, at the same expence, they would give the whole in a present. They even do not insist on their tenants executing such improvements, believing they would be as costly as those they have executed themselves; an expence which they know no tenant could bear. The tenants again perceiving the manner in which these operations are conducted, and the expence they cost, are deterred from making any attempts to meliorate the condition of the lands they occupy, and are confirmed in their prejudices against all improvements. In this manner, the generality of English improvers that have come to Scotland, instead of promoting the interests of agriculture have greatly retarded them, and rivetted the prejudices of the native inhabitants.

Instead of proprietors improving land at their own expence, which generally costs them more than the worth of the land, I would recommend to them to have the necessary improvements executed by their tenants. They ought not, however, to be left to the will of the tenantry, who are generally inclined to adhere to their slovenly habits. A plan of improvement ought to be adopted, suited to the state of the particular farm when it is set; not on expensive or extravagant plans, but on such as are rational and moderate; such as will undoubtedly refund the tenant in the course of his lease, and return the farm much improved at the end of the tack. If every proprietor in Scotland were steadily to pursue such a course of gradual, moderate, and rational improvement, executed solely by his tenants, under the direction of an honest, and diligent land-grieve, the produce of the moorish and neglected parts of the island, might, in the course of twenty or thirty years, be increased ten-fold, and that of the land now arable greatly multiplied.

But to render even that mode of improvement efficient, it

will be necessary for the proprietors to look more attentively to their own business, than many of them have hitherto done. Haughty and barbarous chieftains despised agriculture as the business of women and slaves, acting under their Baillie; and too many of their successors inherit their prejudices, as well as their estates. Others are sunk in frivolity, spending their time and fortunes in trifling or vicious courses. A false etiquette teaches them to despise agriculture, and shun all intercourse with their tenants, and thereby become the dupes of those to whom they entrust their affairs: it is really surprising how ignorant many of them are about their own business. A proprietor of an extensive estate in Lanarkshire, on being told that his factor had imposed on him, made answer, "I know he is a rogue and a peculator, but I am so ignorant of country affairs, that I cannot take charge of my own business; if I did, I would be imposed upon by every one I dealt with. I had better submit to his pilferings, than to those of all my tenants; though he cheats me himself, he will allow no other to do so."

Proprietors of the middle stations, being happily relieved from the delirium of political ambition, have more time to attend to the important concerns of agriculture, than those of higher rank can spare to that interesting business. Their smaller incomes compel them to remain more at home, and take some charge of their own business, instead of being contented with what their Factors and Agents choose to spare for their support. By residing on their own Estates, through the greatest part of the year, they avoid the courses of frivolity and dissipation to which their superiors expose themselves; have free communications at all times, with neighbouring proprietors, husbandmen and their own tenants, learning from them, and by their own experience, much more correctly than they could do from systems of agriculture framed by Book-makers in England, a true knowledge of every relative and local circumstance which affect their own interest, and that of agriculture. Of course their Estates will be generally found to be better cultivated than those of proprietors of superior rank,

It is by proprietors of the middle rank that agriculture is supported. They are not above looking after their own concerns and the improvements of the country.

Hence we find, that wherever the greatest part of the land is divided into Estates of from five hundred pounds, to five or six thousand per annum, improvements are begun and going on with spirit, while those of the great chieftains are neglected. The counties of Air and Renfrew furnish proof of the former, and those of Lanark and Dumfries of the latter.

To every general rule there are some exceptions. The Noble Family of Eglinton, who have long held the largest Estate in the county of Air, have set an example to other proprietors in agricultural improvements. Earl Alexander was the greatest improver of his time in that county, and superintended the improvements himself. The late Earl being bred to the army, did not take charge of the improvements, but appointed Alexander Fairly of Fairly, Esq. as his Commissioner, who introduced great improvements into the husbandry of the county of Air, as may be seen in the Report of that county drawn up for the Board of Agriculture, by the late Colonel Fullarton, and which I have detailed in my Report on that County now drawn up, and printed. The present Earl, and Lord Montgomerie are too wise and attentive to their own interest, to relax in their agricultural improvements. The consequences are, the rental of their Estates is near ten times what it was when Earl Alexander began his improvements. John Earl of Loudoun was one of the fathers of agriculture in Airshire. The Rev. Mr. Findlater, in his View of the Agriculture of the county of Peebles, probably from a sort of districtal vanity, points out Mr. Dalziel, from that county, who, for a few years was factor on the Estate of Kilmarnock, as a person who introduced the turnip husbandry into Airshire; but I can assure the Reverend Gentleman, that John Earl of Loudoun had begun to raise extensive fields of that valuable root, and of cabbages, carrots, &c. in drills, when he and Mr. Dalziel only existed in the loins of their fathers. His Lordship suc-

ceeded to the Estate in 1732, and began his spirited improvements immediately after that period. Mr. Dalziel's factorship only began on that Estate in 1782, and terminated in 1786.

These Noblemen, who both attained the highest honours, and were entrusted with important missions and commands, were not ashamed to attend to their own business, set their farms themselves, point out to the tenants, verbally and on the spot, the improvements they wished to have executed, and to converse freely with intelligent people on agricultural subjects. This was the best security they could have against that sort of imposition sometimes attempted by country people, which they term "*Cheating the Gentry.*"

The Earl of Cassillis is also attentive to the improvement of his extensive Estates, surveys every farm himself, points out what is to be done by the tenant, and returns occasionally to see if his orders have been duly executed. By a free communication with his tenants, he has become well acquainted with every branch of practical husbandry, and instructs them in that noble art. His Grace the Duke of Portland, though he resides mostly in England, is not inattentive to the improvement of his vast Estates in the county of Air. He is just now expending upwards of a hundred thousand pounds sterling, in making a harbour at Troon, and an iron-railway from that to Kilmarnock. The harbour and town of Ardrossan building by the Earl of Eglinton, with the Canal from that to Glasgow, are improvements that exceed any thing now going forward in Scotland, the Caledonian Canal only excepted. The Commoners of that county are no less attentive to the improvement of their Estates. Sir Adam Fergusson, so eminent as a Statesman, and Lawyer, and Colonel Fullarton, who distinguished himself in the Senate, in the Army, and in Science, were always attentive to the improvements of their own Estates, which they superintended themselves, and to those of the county. And the proprietors of inferior rank follow their example. It is not because these proprietors cannot find Factors to whom they can entrust their Estates. There are at present on all the principal Estates in Airshire, Factors, who deservedly possess

the confidence of their employers, the tenants, and all who know them. I wish I could say as much of those in other counties. Proprietors who neglect their own interest, cannot expect that their Agents will duly attend to it. It is sufficient for the servant that he be as his lord.

The lower order of Proprietors have in general paid but little attention to the improvement of moss, or any other description of soil. Some individuals of that rank have no doubt improved their lands with great propriety, but the greater part of those whose property is under two or three hundred per annum, have done less than any other rank of proprietors. Such of them as have recently purchased their property, are the best improvers. They continue for a generation or two the courses of active industry that first enabled them to make the purchase. But pride and indolence gain on the family, and they give up agricultural improvements, and follow hunting, or rather poaching, as their chief employment.

The conflict that some of these small Barons have to maintain, with pride, poverty, indolence, and meanness, renders them extremely unhappy. They refuse to labour, to beg they are ashamed; and they have no other way of supporting an imaginary superiority over the industrious tenants, but by calumny and detraction.

I have known the pride and indolence of some of these *Bonnet-Lairds*, as they are often called, expose them to very great hardships. But when they had sold off their property, laid aside their Baronial dignities, or appendages of heritorship, and become industrious, they have acquired wealth, as tenants of the lands they had sold, and when paying of rent five per cent. of the price. Two remarkable instances in point, occurred on two neighbouring farms, in the vicinity of Loudoun hill, within the last twenty years; where the sons have become wealthy, by cultivating, as tenants, the lands on which their fathers could scarcely support themselves in existence, when free Lairds; and though the sons are now paying of yearly rent more than ten per cent. of the price, at which the lands were sold. The sale of their lands liberated the families from the trammels of indol-

ence peculiar to their rank, and they now manure and improve the moss on which they formerly killed the Game. It is fortunate for the individuals as well as society, when property passes into the hands of others more industrious. I know no class of men who are less disposed to active industry than the generality of small proprietors. When much of the landed property of a parish is frittered down among *Bonnet-Lairds*, the interest of agriculture is retarded, and the peace of society injured. They are jealous and envious of one another, and of every person they think their rival in wealth and reputation. And if they cannot raise their own fame, or better their circumstances, they endeavour to maintain a preference by detracting from that of their neighbours. They are perpetually quarrelling with their Clergymen about stipends, augmentations, localities, kirks, manses, or glebes, or among themselves about superiority, preferences in the church, &c.

SECT. III.

Obstacles to improvement arising from the imperfect state of science, and inattention of Philosophers to Agriculture.

SCIENTIFIC men have certainly done more towards the investigation of the uses and qualities of moss than any other class of men, though in a pecuniary point of view their interest was far from being equal to that of possessors and proprietors. A Peer of the realm, a Senator of the College of Justice, some of the Professors of Universities, a Doctor of Laws, a Clergyman, and two country Gentlemen of considerable knowledge in different branches of science, have all made inquiries into the qualities and uses of moss-earth, and laid the results of their researches before the public. These augur well. But if the importance of the subject is duly attended to, there is still ground for complaint, that the subject has not yet met with that investigation and research which it so justly merits.

Philosophers having once taken up the subject, they will no doubt continue their researches with an eagerness corresponding to its importance. It is to them we must look for more complete knowledge on the subject. Useful discoveries may be made by farmers and others engaged in practical operations; but till these are brought to the touchstone of science, no great dependence can be placed on them. Fertility, or the want of it, may proceed from causes very different from those to which, in the eyes of a farmer, they may seem imputable; and till the real causes are ascertained by repeated experiments, made by men conversant in science, nothing anent them can be trusted to.

The intimate connection between chemistry and agriculture, has been pointed out by the Earl of Dundonald, and is now recognized by all. It may therefore be expected, that, by the united efforts of chemists and agriculturists, every thing regarding that communication will be traced to its source; and the qualities of moss, though among the last, will not appear a subject of the least importance.

In tracing that connection, the technical language of chemistry stands as a bar in the way of the farmer. The terms in that science having been invented and used by Philosophers, in different countries, and speaking different languages, they have been taken from the dead languages, that they may be intelligible in all countries. These terms are numerous, and cannot well be curtailed. In the imperfect state of that science, the chemical nomenclature has undergone several changes, and may still be subjected to more. These are great difficulties in the way of the illiterate farmer, but they cannot easily be removed.

There appears, however, among some, an inclination to multiply these difficulties on the reader; and but seldom due pains are taken to simplify these terms. Simplicity of terms does not seem to be much in vogue at present. Even the farmers, when they commit their ideas to writing or print, search land and sea, and ransack the classics ancient and modern, for

sounding terms. A fastidious ploughman, however meagre his ideas, or limited his education, would be ashamed to speak of a *clay* or *sandy* soil, or that formed by water. These he would consider as clumsy terms. He talks of *Argillaceous*, *Silicious*, *Alumine*, *Delta* ground, *Alluvial* soil, &c. *Heat*, *cold*, and *air*, are beneath his notice ; *caloric* and *gas* are more genteel. If *cold* be mentioned he sneers, and says it is not a positive quality, but the mere absence of caloric.

It is very common for people in every situation in life to transfer the technical terms of their own profession to every subject of which they speak ; but the Book-making farmers abandon the plain and simple language of their own art, as low and degrading, and attempt to foist on their brethren the technical terms of other sciences. This evil proceeds from the vanity which writers on agriculture have to be accounted learned ; and generally, the less claim the author has to learning, the more ambition does he show to assume an apparent profundity ; or at least to show "a little learning."

The Ministers of the Church of Scotland have great merit in the interest they have taken in agriculture, and the valuable writings so many of them have laid before the public on that interesting subject. The Statistical Volumes are creditable to many of that order, and the County Surveys, and other works written by Doctors Robertson, Smith, Thomson, Douglas, Singers, Grahame, Rennie, Messrs. Headrick, Findlater, Ure, Johnston, and others, do them honour.

The example which many of them set to their parishioners in agriculture, promises results highly beneficial to the community. Their erudition and liberal sentiments, eminently qualify them for the dissemination of useful knowledge in that science, and to banish prejudices and bad habits from among their parishioners.

To render them still better qualified to promote the improvement of their parishes, they ought to attend Lectures on Chemistry, Agriculture, and Natural History, during the time they attend the Divinity-hall ; spend two or three seasons with some eminent farmer ; learn to perform every operation in

husbandry, and all of them should undergo an examination on agriculture before they obtain a Presentation.

Having received a charge, they should be bound to give Lectures on the elementary parts of Chemistry, Agriculture, Botany, and Natural History, in a plain and familiar style, adapted to the capacities of their parishioners. Lectures on these subjects ought to be delivered weekly at every market town. Some of the farmers might not attend, others would take their nap as they usually do on Sunday, but many would attend and improve.

The present expensive, mean, and vexatious mode of levying bear and meal from their parishioners, in firlots, pecks, and lippies, like the knaves at a corn-mill, and money in shillings and pennies Scots, like mendicants, and wrangling in courts about augmentations, modifications, and localities, which disturb the peace of the parish, mar the usefulness of the clergymen, and render them unhappy. This ought to be done away, and the living provided in land only. The heritors might be bound to purchase as much land in every parish, as the proven rental would be equal to the present stipend. This would put an end to all future wrangling about augmentations, localities, and the quality of the grain, connect the interest of the clergymen with that of agriculture in general, and that of their parishioners in particular, and give much greater scope to their industry. They would not need to apply to a Court of Law, and maintain, as at present, an endless litigation for augmentations. They would obtain them from their own industry, in improving their glebes. They would no longer imbibe the dull spirit of monkish indolence; nor affect a seclusion from the world, nor rust in their parlours. The management of their glebes would call forth the energies of their body and mind, in honourable and active exertions; and while they reaped the fruits of their labours, they would become still more useful in society.

SECT. IV.

Obstacles to the Improvement of Moss arising from the inattention of Government to the subject.

GOVERNMENT have not, in my humble opinion, paid that attention to the improvement of moss soil, and the reclaiming of waste ground, which a matter of such high national importance seems to me to demand. The efforts of individuals, however commendable, will avail but little, if they are not seconded by the fostering hand of Government. And I sincerely believe, that few subjects will be found better to deserve legislative aid, than the interests of agriculture in general, and that of reclaiming moss and waste land in particular.

Agriculture being the most important of all the concerns of mankind, it certainly ought to be the first object of legislative attention. No nation can prosper, for any length of time, that is not attentive to a concern so highly interesting; and those nations who have been the most attentive to agriculture, have always had the greatest share of prosperity. The Chinese Government has always made agriculture the chief object of its care; the consequences are, the country is rich and populous above all others, and the Government has been the most permanent in the world.

Commerce and manufactures are no doubt of high importance, and every wise Government will promote them, but when compared with agriculture, they are but secondary objects. They are much more fluctuating and uncertain than that noble art, and the fortunes of those who are engaged in them are held by a much more precarious tenure.

A nation may be rich and powerful by paying due attention to agriculture, even though trade and commerce have failed. It is long since the trade of Antwerp, Ghent, and Bruges were annihilated; but Flanders, by a wise attention to agriculture,

continues to be one of the richest and most populous countries in Europe.

If we wish to reap any permanent advantages from trade or manufactures, we ought to render these subservient to the interests of agriculture, which is the foundation of national prosperity. But if the interests of agriculture are neglected, or rendered subservient to trade or manufactures, the nation that does so will have cause, sooner or later, to repent its error. Whatever advantages individuals may reap from trade or manufactures, whenever they are suffered to supplant or injure agriculture, they will lead to national ruin. If the dreams of prosperity from these sources, should induce us to neglect agriculture, and become dependent on foreign nations for a large proportion of our food, the national spirit and independence, and that dignified importance which Great Britain now holds among the nations, will soon be lost.

The health and vigour of people who are employed in cultivating the ground are so far superior to those who are engaged in the manufacture of cotton goods, that a stranger would scarcely believe they were composed of the same race of men.

The patriotic Lord Kaimes planted a colony of Highlanders on his moss at Blairdrummond, and taught them to reclaim the soil, then scarcely worth a penny per acre. Much about the same time the late David Dale, Esq. transported several hundreds of Highlanders to his cotton mills at Lanark, where he employed them in preparing and spinning cotton. Lord Kaimes gave his colony but little aid, farther than providing water to float off the moss, and teaching them to become industrious. Mr. Dale gave high wages, furnished good lodgings, schoolmasters, preachers, &c. But such are the advantages of agricultural pursuits, that the moss colony remain healthy and happy, delighting in their situations, warmly attached to their patron, and to the Government, daily increasing in wealth, and rearing a numerous offspring, ready to extend their brawny arms, in the cultivation of the dreary wastes, or to repel their country's foes. While the cotton mill colony, with much greater encouragement, contracted strong aversions to their

employment, became discontented with their situation, and soon abandoned it. I have often looked at both colonies, those at Blairdrummond with delight, and the other with sympathy.

If the two colonies are considered in a national point of view, the advantages will be greatly in favour of the settlers at Blairdrummond. The profits arising to Mr. Dale, or Lord Kaimes' family, are only individual concerns. But several hundreds of ignorant and indolent Highlanders, converted into active, industrious, and virtuous cultivators, and many hundreds of acres of moss of the least possible value rendered equal to the best land in Scotland, are matters of the highest national interest, to which I can discover no parallel in the cotton mill colony.

I saw some of the healthiest and most active workmen to be met with any where, labouring to Mr. Roscoe, at Chatt Moss, and next day I saw thousands of poor unhealthy dissipated beings, at the cotton factories in Manchester. The view I got of that manufacturing place was really distressing to my feelings; disease and debility were perceptible in many faces. The contamination of morals was sufficiently obvious, and the riots which broke out a few days after I left that place, prove how discontented these people were.

The cultivators of the ground raise to their country an offspring that are strong, healthy, and robust, delighting in the occupation of their parents, attached to the Government, and ready to oppose a powerful arm to their country's enemies: while the sickly inmates of a loom-shop, or a cotton mill, raise an unhealthy and puny race. The farmers are strangers to the vices and courses of dissipation so common in towns where manufactures abound. The avocations of husbandry naturally cherish in those who are engaged in them, habits of peaceful industry, and the practice of public and private virtue.

Attachment to Government has ever been considered as the greatest virtue, and the want of it has been regarded as the worst of crimes. Such attachment is no where stronger, more virtuous, and less interested than it is among the peaceful cultivators of the ground. Even the labourers of the lowest rank are much more attached to their masters, and these to the pro-

prietors, than people in the same rank, employed in trade or manufactures. Farmers' servants are satisfied that justice is done them, that their masters reap no undue advantage of them; that happen what may, they will be employed on fair and equitable terms, and if they persist in their industry, they may raise themselves to the rank of farmers. If one master fail, or turn them off, they can find many more in every parish. But a mechanic in the cotton trade, is a mere article of commerce, bought and sold, several times every year their wages are changed, sometimes every week. Several hundreds of them are slaves to one man, or one company, who though their profits are sometimes enormous, can give no security for continuing their people in pay even for one month. If they leave one master they must travel far to find another, and submit to any terms he offers. They have not the attachment to their employers that labourers have to the farmers, or the farmers to the proprietor; neither have they the attachment to Government, that is met with among the people employed in agriculture. No change can place them in a worse situation. Confusion may throw something in their way, but can take nothing from them. They consider themselves as mere slaves, bought and sold by their employers; and if a Revolution does not meliorate their condition, it can scarcely make it worse.

Whether the cultivators of moss may reap an immediate return or not, still the national interest is promoted, even in the attempt. For no species of labour in which mankind were ever employed can be more conducive to health, or less exposed to the contamination of vice, than the improvement of the moss-soil. None was ever better calculated to increase population, and the means of supporting that increase. Nothing could tend more to beautify and enrich the country, multiply its produce, and meliorate the severity of the climate. And no occupation is better calculated to cherish in those who are engaged in it, a love for their country, and attachment to its Government, than the healthful, innocent, and virtuous pursuits of agriculture in general, and reclaiming of moss ground in particular.

The singular situation in which this country is now placed, calls loudly on the Legislature, to adopt such measures as may induce the proprietors and possessors of such ground, to improve it, to the highest pitch of which it is capable. So long as the profits arising from trade and manufactures, were such as enabled us to purchase food from foreign countries, at a lower price than it could be raised at home, some excuse (though not a good one) might be pled for the neglect of such improvements. But now that our manufactures are shut out from almost every port in Europe and America, and we cannot be allowed to purchase grain any where, the neglect of agriculture is an error bordering on infatuation.

It appears from the proceedings in Parliament on the Bill for prohibiting for a time the distilling from grain, that eight hundred thousand quarters have been imported annually on an average of several years past. That law has been calculated to make up one half of that deficiency. But how in the name of wonder is the other half to be supplied? Not from America, or the Baltic, as formerly, nor from any foreign nation, or colony not our own. We must either increase our produce by improved cultivation, or be put on short allowance during the continuance of the war.

But if we could be certain that in no case the deficiency would exceed that of the average of these years, our difficulties might be removed, by limiting the number of idle horses, dogs, &c. But when we consider that that was the average deficiency of a series of years, several of which yielded abundance, the deficiency of some of these years must have been to the extent of several millions of quarters—when we consider that we have lately experienced some crops short of one half of national subsistence for one year, that several such crops followed each other about a century ago, and that the same thing may yet occur, we will find abundant cause for more serious alarm. Such seasons have been seen, and such may come round, before we find a Joseph to fill our granaries, or years of plenty from which they can be supplied. If so, our situation must be truly alarming. We can average our loss and gain for any

given period; but we cannot make averages with hunger, for more than one day. Should such a year of scarcity as have been met with oftener than once within less than thirty years, overtake us during the war, in the shape it has now assumed, we should be compelled, like Esau, to sell our birth-right, of which we are so justly proud, and for which we have been so much envied by other nations, for a morsel of pottage.

These observations are not intended to create alarm, but merely to rouse the nation to a just sense of the danger to which we stand exposed, and to direct to the only remedy that can be applied. That remedy is the cultivation of our Mosses, wastes, and commons, and making every other improvement in the soil, of which it may be found susceptible.

If we remain, as at present, shut out from all the ports of Europe and America, nothing but the utmost exertions, in every department of agriculture, can preserve our independence, our maritime rights we hold so dear, or even our existence as a free and independent nation, beyond a single year of scarcity equal to 1782 or 1799. We cannot tell how soon such a season, or one worse than either may come. Nor can such a calamity be prevented by any human power. All that can be done is to make every rational provision for such an event, if it should, in the course of providence, fall to our lot. And if we are not infatuated, we will make every exertion to place ourselves out of the danger to which such an event would expose us.

But independent of that extraordinary necessity, which I trust will only be temporary, there are other considerations, which should induce the Government to encourage, and even enforce the cultivation of moss and moor ground.

A great population has always been considered as the strength and bulwark of a nation. In the particular situation in which Great Britain now stands, an increase of population is become much more necessary than it ever was, in this or any other nation. The history of the world affords no instance of a kingdom, so small as that of Britain, holding colonial

territory to such an extent as she now holds, and in so many distant and detached quarters of the world; and that kingdom at the same time, having to contend with the whole civilized world, mustered and led on by the most successful, and most consummate General the world ever saw. In a situation so unparalleled, every effort should be made to increase the population of the mother country.

Such increase of inhabitants is not to be procured from manufactories; for most of them are unfavourable to health, and have a tendency to diminish the number of men, and debilitate the human frame. It is only by encouraging agriculture, and promoting the fisheries, that a strong and hardy race of men can be reared, able to set at defiance the tyrant of Continental Europe. The Vaccine Inoculation will certainly increase the population of Britain. But what will such increase avail, if there is not a corresponding increase of food? An increase of population, without great improvements are made on the soil, would add to, and no way diminish our difficulties; but if due attention were paid to the cultivation of the mosses and waste ground, it would tend to increase the population, and the food of man, and greatly multiply the national strength.

The improvement of moor ground, and encouraging the fisheries, appears to me to be much sounder policy, than allowing the cotton manufactories to depopulate the country, and contaminate the morals of the inhabitants. I humbly think, that these two great national improvements, and sources of wealth, might be carried on at one time by the same individuals; who might also be enrolled as seamen, ready to man our fleets at a moment's notice, or trained to arms as defenders of the country.

The enemy we have now to cope with, carries on his plans with the rapidity of lightning, and he is as busy in scheming and preparing for the overthrow of other States, when at peace, as when he is at open hostilities. The present war cannot be carried on for ever. But if peace should be made with such a man as Buonaparte, the dispersing of our sailors would

be a serious evil, if ever the Tyrant of Continental Europe should again take up arms, which he certainly will do the moment it can suit his convenience.

To prevent our being taken by surprise while our seamen were scattered in distant parts, a strong body of them might be kept in some sort of pay, and employed in the fisheries. As the herring fishery continues but for a few months every year, and as many of our honest Tars might wish to enter into matrimony, and spend some part of their time on shore, building and launching some young sailors, each of them might be provided with a small plantation of moss or moor ground, which with due attention they might soon render capable of supporting two milk cows, and of yielding food for their wives and children. And by greater exertions, they would in course of time render it still more productive.

There are few parts of Scotland more than a day's journey from the shore, so that they could soon travel from their plantation to their fishing boat. They might be allowed the choice of the county in which they fixed their residence; as there is plenty of land for their use in every county of Scotland, now altogether neglected.

I cannot discover any method by which our sea and land forces, or at least a large part of a supplementary force, for both army and navy, could be so advantageously employed during peace, or some part of them even during war, as in the fisheries, and in reclaiming each a small lot of ground sufficient to support his wife and children. Such rural industry is much better suited to a military life than being cooped up like prisoners of war in Barracks, or lounging idle in large towns, where they run the hazard of having their morals contaminated to the utmost degree of human depravity, and their health and constitution impaired in the dram-shop, and the most infamous scenes of debauchery. A regiment trained up in such habits of industry, and employed in exercises so manly and invigorating, who were strangers to vice, and whose constitutions were sound and unimpaired, would be three times

more valuable than one composed of *Jail-birds*, and of the dregs of society, whose health had been impaired by unwholesome manufactories, and their frames debilitated by vicious habits.

Their houses, land, and little stock, would give them a patrimonial interest in the country. Their wives and children not the miserable, dejected, and worn out creatures we see following a regiment, or the parochial paupers which the soldiers leave on the pension list, generally destitute of health and of virtue; but vigorous and uncontaminated, supported, not by the Treasurer for the poor, but from their industry, on their little farm, which even in the absence of their husbands they could manage, would give them an interest in the country to defend. Conjugal attachment and fidelity may subsist between some of our soldiers and their wives, great as may be the hardships to which they are exposed; but with many of them, these virtues are extremely slender, if they at all exist. Not a few of them are rather wives to the regiment or troop, or to every other comer, than of any individual. Their dissolute lives, taudry dress, and miserable aspect, are degrading, not only to the army, but to human nature; but wives brought up in the habits of rural industry, strangers to vicious habits, strong and virtuous, with their healthy children, would be much more endearing to their husbands, and their protection and well being would be more deeply impressed on their minds, that the degenerated miserable creatures that usually follow the camp.

The greatest part of the children of soldiers fall sacrifices to the diseases and vicious habits of their parents; their inability to support them, or the hardships they are subjected to in following the route of their corps; and are thereby lost to their parents and to the nation. Many who survive, bear through life the direful effects of the vicious lives of their parents; but those reared by healthy and virtuous mothers, would be more healthy and virtuous as well as much more numerous. Fishermen are generally of all others the most prolific.

Forty or fifty thousand men might be kept in Scotland alone,

ready to man the fleet or join the army whenever needed; and in the meantime, till called on for national defence, they could be employed in the fisheries, and each of them have as much land as would keep, when cultivated, two or three cows. By this mode of improvement, near a million of acres might in the course of twenty or thirty years be reclaimed, and rendered worth forty times its present value, many thousands of healthy, hardy and virtuous children would be reared; a strong national defence would be always ready, and till needed would be usefully employed. Their wives and children would be happy and uncontaminated, and the fisheries, hitherto so much neglected, would become a source of national wealth.

Much has been said about the proprietors of land in the Highlands turning off the inhabitants, to make room for sheep. The hardships which the poor Highlanders were subjected to, in being thus driven from their native country, and compelled to emigrate to America, has been lamented in the most feeling strains. Much as I condemn the policy which has depopulated so much of the north of Scotland, and felt for the natives who have been turned out, I cannot blame the proprietors of these districts for turning their land to the best account to them and their families. Extensive ranges of the southern counties, which are less mountainous, and much more propitious to cultivation, have long been devoted to sheep walks, and are as thinly inhabited as the districts whose depopulation has been the subject of such lamentation; yet no one complains of that mode of husbandry, or says that these parts of the country are depopulated.

The truth is, the southern districts have for time immemorial, been devoted to the pasture of sheep; but as no change has taken place, the error of that course of husbandry, and the injury it does in keeping the country as depopulated as the northern districts, passes unnoticed and unlamented; whereas in the north, the country was once much more populous, and the introduction of the sheep has diminished that population.

The proprietors in both districts are certainly blameable, in sacrificing the public interest, to their own present profit.

But I cannot perceive that those in the south are less culpable than those in the Highlands. On the contrary, they seem to me much more inexcusable, because their ground is much more propitious to cultivation than the mountainous districts in the Highlands, and lies nearer a market for the sale of their produce. Both have to plead in excuse, that in the mode of occupation they study their own interest, according to their knowledge of agriculture, and in doing so they transgress no law.

If these modes of husbandry are really injurious to the national interest, the blame rests on the Government. It will be time enough for the proprietors in either district, to obey the laws, when once they are framed and promulgated. At present there is no law, and therefore there can be no transgression.

I am of opinion, however, that the sheep husbandry is of all others the most proper in such districts, in the state in which they now are; but that it would be much for the interest of the proprietors, the occupiers, and the nation at large, to break in upon these sheep walks by cultivation. I would not advise the removal of the sheep, or the too speedy introduction of the dairy, or any other mode of occupation; but I would have the cultivation immediately begun, and added to every year, so much according to the extent of land in the farm capable of being reclaimed, and that partial cultivation persisted in till the whole was capable of being improved. This seems to me so much connected with national prosperity, as well to merit legislative interference. I shall not offer to frame the heads of a Bill, or to point out in what manner the improvements I recommend are to be carried into execution. Leaving these to the wisdom of Parliament, I shall only say, with the fullest conviction in my own mind of the correctness of the principles, that such improvement would add much to the wealth, prosperity, and security of the nation, and therefore it becomes a proper subject for legislative consideration.

I should much wish to see the subject brought into Parlia-

ment, not merely to prevent emigration from the north, but also to increase population in the south.

I do not wish to be understood as vindicating the conduct of the Highland lairds, in hunting away the native inhabitants, to store their estates with sheep and indolent shepherds. I had often read with sympathy the detailed accounts of these emigrations, and lamented that the national interest was so palpably overlooked, in a matter so highly interesting. But an accident occurred, which made me an eye witness of these scenes of distress, and the impression it made on my mind, will not soon be eradicated.

I reached the Inn at Aviemore in Badenoch, on my way to Caithness, on the evening of the 14th August, 1805. A large fair having been held that day at Ruthven, a few miles distant, and several shooting parties being lodged at Aviemore, and as I travelled on foot, I found there was no room for me in the Inn. I was obliged to sleep in a room over a hall, where common travellers are entertained; before I got asleep, I heard the noise of a large company in the hall under my room, who I conjectured were people returning from the fair; they made so much noise as kept me from sleep, and I could discover that some of them were in tears. Hearing a servant in the next room, I inquired who they were that occupied the hall, and what was the cause of their lamentations; when she told me they were a colony of Highlanders, who had come from beyond Inverness, and were on their way to America, and that their tears had not dried up since they had begun their journey. This information removed all fears for my own safety, but my sympathy for these poor people was so much roused, that I did not sleep one moment during that night, though I had travelled on foot, from Blair-Drummond to Aviemore on the three preceding days, nearly fifty miles each day.—Every groan from below reached my heart.

As a shilling was demanded for each bed, none of them could afford to pay that price, and they all remained in the hall; they had worship performed with great solemnity, and apparent devotion; none sung save those who could do so

with decency, a rule that ought to be observed every where, as nothing can be more indecent, than for people to disturb the melody of worship, who cannot sing with propriety.

Finding I could not sleep, I rose early in the morning, and spent some time in conversing with these poor people. I found they exceeded sixty in number, of all ages, going with their whole effects to Greenock, about two hundred and fifty miles from where they had set out, to sail from thence to America. I never saw so many people together so much dejected: though the whole had been under sentence of death, they could not have been more cast down; their sighs and tears made an impression on my mind, which will continue while I live.

In ruminating on the case during a sleepless night, I put many questions to myself on the subject, as,—How lamentable is it to see these unhappy people compelled to leave their native glens, where they and many generations of their ancestors have lived, and to seek refuge in a foreign land? What hardships must they suffer before they can reach Greenock by land; get from there to America, in the hold of some ship, and then begin another journey of many hundreds of miles, through the deserts of America, to obtain, not a cultivated spot, but first to purchase, and then clear and cultivate a desert, at a distance from the civilized world, exposed to the ravages of wild beasts and savage tribes? Good God! is there no land in Scotland that these poor people could be employed to reclaim? Yes, there are many thousands and millions of acres there, as eligible for cultivation, as any they could obtain on the other side the Atlantic. Why then are these simple, innocent, ignorant people, driven with such unrelenting cruelty, into exile from their native land, to which they are so much attached, and compelled to seek, with heavy hearts, an asylum in the deserts, and among the savages of America? Have the proprietors (now that feudal vassalage is abolished, and their retainers cannot be called out to fight under their standards, as in former ages) neither humanity to their clans, to induce them to prevent their emigration, nor

the sagacity to see, that by employing them in cultivating the ground, they would triple, in a short time, the value of their own estates, and consolidate the strength and prosperity of the nation? Are the proprietors in the north of Scotland so infatuated, as to regard nothing on their estates, but the rents they bring, and to sacrifice all prospects of increasing the value of their properties, by improving the soil? Has the virtuous spirit of the patriotic Lord Kaimes, been infused into no other but his own son, and Sir John Sinclair? And is the British Government equally blind to the sufferings of these her own children, and to the national interest?

Sir John Sinclair has set an example to other proprietors, worthy of their imitation; his estates, like the generality of those in the North Highlands, were, considering the state of cultivation, rather overstocked with inhabitants, who lived partly by fishing, &c. He wished to make improvements, but he did not wish to reduce the population too much: to accomplish both purposes, he laid off convenient farms for improved cultivation, and after enclosing, fallowing, manuring, &c. and building suitable houses, he set them to tenants, who carry on a liberal and improved course of husbandry, equal to that followed in the southern counties. I had the honour to ride over with Sir John the principal part of his estate, in August 1805, and found many large farms already brought under the most improved courses of cropping, occupied by tenants, who farm their lands on liberal plans, and who possess the manners of gentlemen. There are at least, forty or fifty of the tenants, upon Sir John Sinclair's estates, that he might introduce with credit, to the table of any nobleman in the City of London*. And many of them are accommodated with Houses, superior to the generality of the Ministers' manse through Scotland.

But while he has been attentive to the improvement of his estates on liberal plans, and the improvement of society in

* I do not believe that the first Duke in Scotland, whose estates bring ten times the rent of those of Sir John Sinclair, could introduce ten of his tenants, with credit, at a dinner of the Presbytery, or country Justice.

that remote district, he has not overlooked the state of the native inhabitants, or diminished the population of his estates.

He has demolished the clusters of huts which the native inhabitants occupied, and converted the materials into compost; laid off farms of two hundred or three hundred acres, at convenient distances; and, intermixed with these, he has planted colonies of Highlanders, with lots of from five to twelve or fifteen acres each, built, or assisted the occupants to build, a handsome cot, and bound them to dig up, reduce to proper form, manure, and crop on liberal plans their little plantations. These colonists work occasionally to the large farmers, and at fishing, &c.; and being compelled to labour their land on improved plans, they live comfortably, improve the ground, and keep up the population. The same modes of improvement, and of keeping up the population, ought to be followed in all parts of Scotland.—The improvements carried on by the Earl of Caithness, Sir Benjamin Dunbar, James Trail, Esq. and some others of the proprietors of land in Caithness, do them great honour.

I have often complained, that so many of our wealthy proprietors are eager to increase their estates by making new purchases, from which they could seldom draw four per cent of the price; while by laying out their money in judicious improvements, on what they already held, they might draw ten, twenty, and sometimes forty or fifty per cent.

The same mania seems to have seized the Government. They fit out expeditions, and carry on wars, to acquire distant and unwholesome colonies, at a hundred times the expence which would reclaim a district, and add a colony to Britain within itself. Many thousands of her subjects, and millions of her money, have been lavished in the conquest of pestilential islands, in distant regions, inhabited by savage tribes; which we can only hold by a precarious tenure, at much expence, and without advantage, save to the governor, deputy-governor, commandant, &c. Had the tenth part of the sums that have been squandered on Quixotic adventures, been laid out with judgment, in cultivating the mosses, moors,

commons, and waste lands in Britain, our population might have been doubled, and the nation become invulnerable to the united force of Europe.

Let us therefore desist from foreign conquests, and from war, except for self-defence. Let us wage internal war against the commons, wastes, moors, and mosses of our native soil. Let us encounter the heaths, and fogs, and barren herbage, which are our greatest enemies; and let us never lay down the weapons of our warfare, till we have extirpated their whole race from our native land, till the barren wastes, and neglected deserts, be converted into fruitful fields; till the wilds of Caledonia, and commons of England, be made to bud forth, and blossom as the rose, and to bear fruit like Lebanon.

These would be conquests worthy of men. Happy had it been for the inhabitants of Europe, if their sovereigns had never led them forth to any other species of warfare.

CONCLUSION.

HAVING inquired into the origin of moss-earth, mentioned the qualities it contains, so far as these are deserving the notice of the cultivator; pointed out the uses to which that substance can be converted; given directions how it should be treated, so as to obtain the greatest benefit from the operations recommended; having shown what has been achieved in Scotland and in England, and noticed the interest which possessors, proprietors, philosophers, and the nation ought to take in the improvement of that species of soil; I shall now take my leave of the subject, with the sincerest wishes, that the public may derive benefit from my labours. In whatever light others may be disposed to view the subject of which I have treated; to me it has appeared as one of great importance. Not to myself indeed, more than to any other obscure individual, but to the British nation, and to every individual of which that nation is composed, in proportion to the rank they hold

In the scale of society, and the interest they claim in national prosperity.

When I consider how large a portion of the surface of Scotland is now buried deep under cold torpid moss-earth—how injurious that substance is in chilling the atmosphere, and benumbing vegetation—how rapidly it is increasing—how easily its growth might be interrupted, its pernicious effects removed by cultivation—how profitable to the proprietor, the possessor and the nation such cultivation would be: I cannot refrain from expressing surprise and regret at the little attention that has been hitherto bestowed on a matter of such general interest. To rouse my countrymen from what appeared to me a culpable indifference in an interesting matter, has been the most ardent wish of my heart.

For that purpose I wrote and published under the greatest disadvantages, and circumstances the most discouraging. From the same motives, and to render this publication worthy of the patronage under which it is to be ushered into the world, I have travelled to the remotest corners of Britain, to acquire knowledge and collect information on the subject. And from these motives alone have I spent many days and nights in ardent research, and tiresome labour, preparing this publication for the press, and that I might convey in it to the public, every useful information I have been able to collect.

The exertions made to prepare and bring forward the former publication were amply rewarded, and my ambition gratified, in the notice that was taken of that pamphlet, and the pains which many Noblemen and Gentlemen have taken to circulate it among their tenants. A grateful sense of the honour done me, and an ardent wish to render this publication useful, has stimulated me to make every exertion I was able.

It has been satisfactory to me and beneficial to the public, that others of superior abilities, and greater erudition have published on the same subject. I have derived much valuable information from their labours, and I trust they will prove highly useful to the nation. I have not been able to subscribe to every thing they have written. Wherever I have differed from

one or other, I have given my reasons of dissent, and the impartial public will decide. I trust these authors will be satisfied, that though I have treated their writings with freedom, I have acted with candour. Every man has his own way of expressing his sentiments. Mine is not the most courtly, but I hope it will not appear to be uncivil. In writing, my first care is to express my opinions so as they may be understood. I have often admired the refinement which I could not imitate; but I would much rather express my sentiments in plain and direct terms, than leave them to be taken up by implication.

Another source of consolation arises from the exertions that begin to be made in all parts of Britain, in reclaiming moss. I could have pointed out hundreds of instances, where small patches of moss have begun to be improved, and become productive. It is in that way that moss can be reclaimed to best purpose, and with least risk. If possessors of small farms would reclaim even one acre, and those of larger farms from three to five acres annually, several hundred thousand acres would every year be added to the productive soil of Scotland.

If any thing I have done, or can effect, shall have the tendency to stimulate the proprietors of land, or their tenants, to make further exertions in reclaiming the mosses on their Estates; induce others to throw greater light on the interesting subject, or even to point out the errors I may have fallen into, my highest ambition will be gratified. My sole object has been, and still is, to rouse the attention of my countrymen to a matter that seems to me intimately connected at all times with national prosperity; and which in the present unprecedented state of Europe, involves in it, eventually at least, the national safety. If my ardent wishes shall be realized, I shall be extremely happy. If they are not, I shall still have the consolation of having done my utmost to promote the prosperity of my country.

ERRATA.

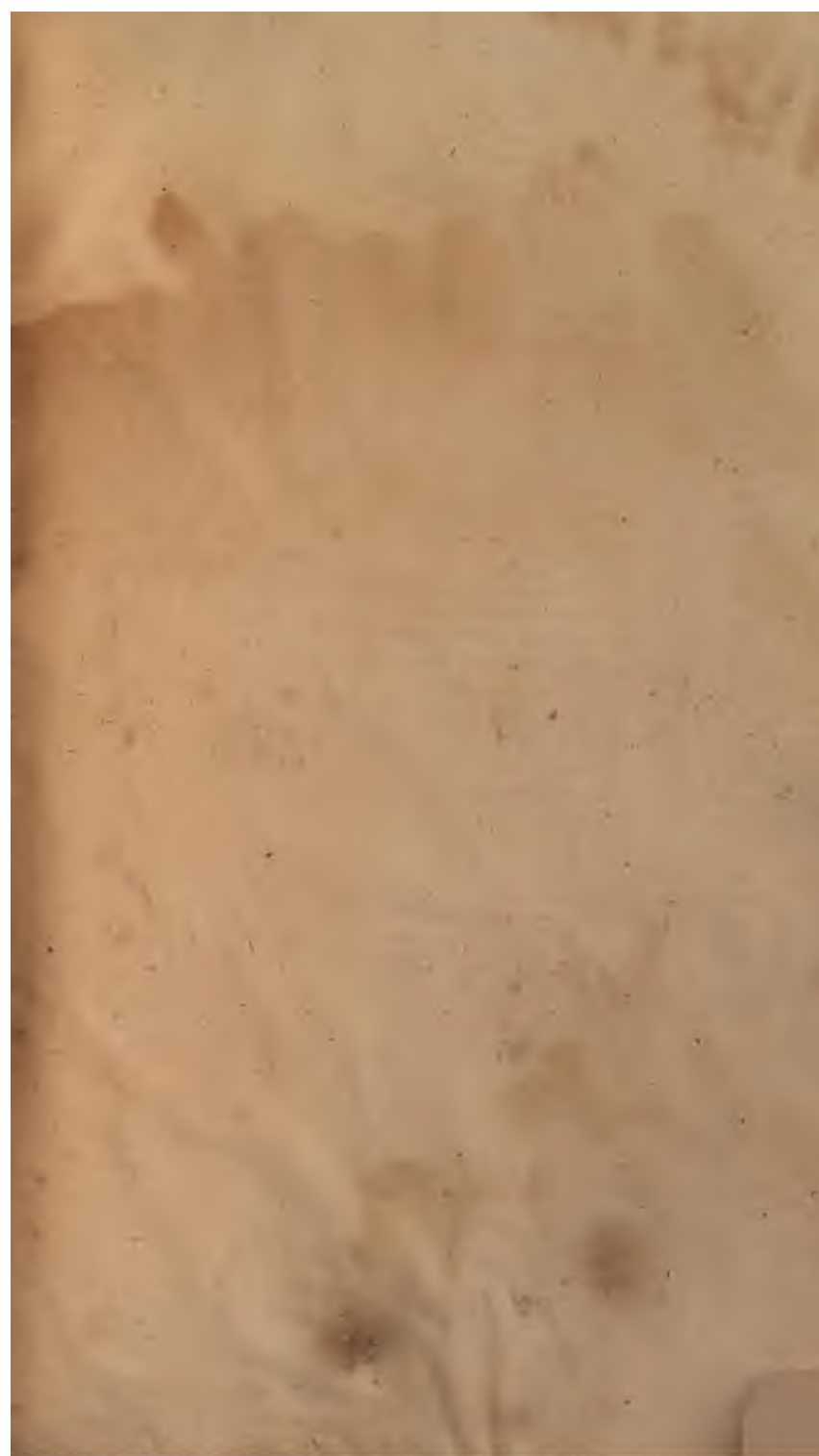
PREFACE AND INTRODUCTION.

Page.	Line.	
xi	6.	<i>for propietion read propitiare.</i>
xii	25.	<i>for interrupt read interrapt.</i>

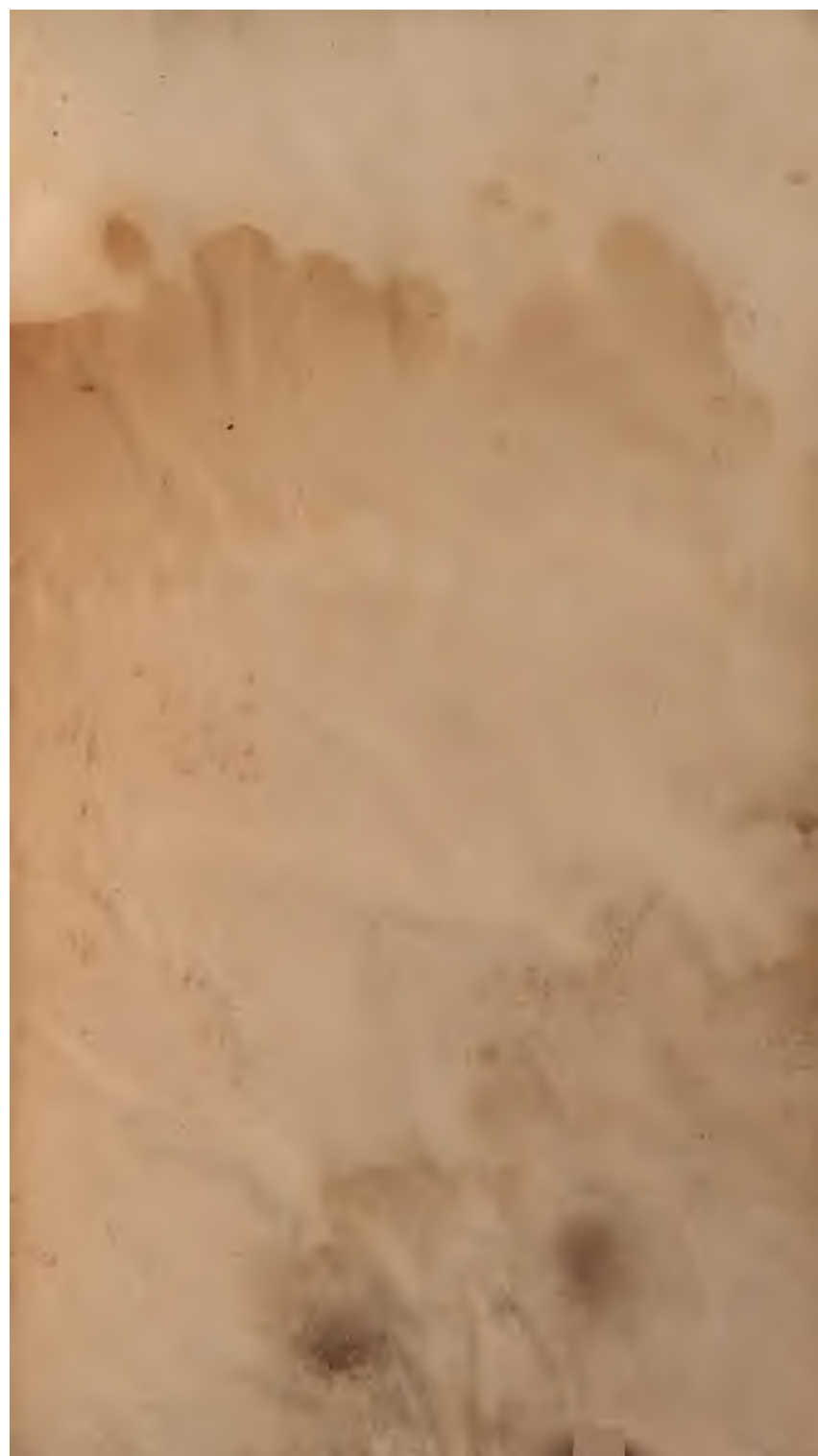
BOOK.

2	20.	<i>for most real and interesting read real and most interesting</i>
6	25.	<i>for a read various.</i>
8	24.	<i>for would read must.</i>
16	24.	<i>for the read their.</i>
30	20.	<i>for there read their.</i>
40	20.	<i>for made in temperature read made and in temperature.</i>
42	24.	<i>for pink read plant.</i>
52	4.	<i>for Davy read dary.</i>
222	6.	<i>for here read here.</i>
242	24.	<i>for citation read truhion.</i>
252	25.	<i>for propertion read preparation.</i>
260	24.	<i>for affected read effice.</i>
274	24.	<i>for ends read words.</i>
278	25.	<i>for the Justice are probably read the Justices are not probal</i>
282	22.	<i>for stalks read stacks.</i>
—	20.	<i>for virtut read value.</i>
296	22.	<i>for grain read green.</i>
298	22.	<i>for greens read grain.</i>
298	32.	<i>for Kaim read Kaim.</i>
298	22, 23.	<i>for quoline read quantities.</i>
299	2.	<i>for two Pounds read two Shillings.</i>
297	3.	<i>for twenty each read twenty Shillings each.</i>
320		<i>for Sect. VII. read Sect. II.</i>
348	26.	<i>for that read than.</i>

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1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26



ERRATA.

PREFACE AND INTRODUCTION.

Page.	Line.	
xi	6,	<i>for proprietors read projectors.</i>
xx	12,	<i>for intercept read interrupt.</i>

BOOK.

4	20,	<i>for most real and interesting read real and most interesting.</i>
6	36,	<i>for a read various.</i>
8	14,	<i>for would read must.</i>
16	36,	<i>for the read their.</i>
30	20,	<i>for these read their.</i>
40	30,	<i>for mode in temperature read mode and in temperature.</i>
64	26,	<i>for plank read plant.</i>
87	4,	<i>for Davy read dary.</i>
133	6,	<i>for forest read forret.</i>
143	24,	<i>for cohesion read cushion.</i>
152	25,	<i>for proportion read preparation.</i>
160	31,	<i>for affected read effete.</i>
171	30,	<i>for seeds read weeds.</i>
178	35,	<i>for the Justices are probably read the Justices are not probably.</i>
234	11,	<i>for stalks read stacks.</i>
236	30,	<i>for virtue read value.</i>
236	22,	<i>for grain read green.</i>
239	11,	<i>for greens read grain.</i>
266	30,	<i>for Kairn read Kaim.</i>
268	18, 19,	<i>for qualities read quantities.</i>
290	2,	<i>for two Pounds read two Shillings.</i>
297	3,	<i>for twenty each read twenty Shillings each.</i>
320		<i>for Sect. VII. read Sect. II.</i>
348	26,	<i>for that read than.</i>

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